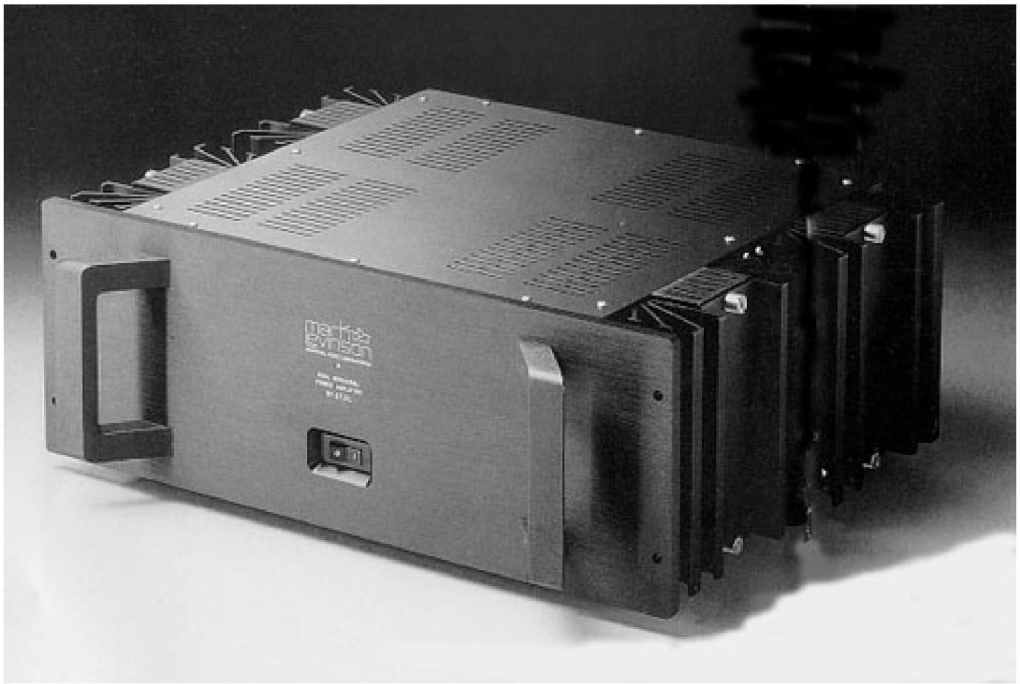
No27

Dual Monoaural Power Amplifier

SERVICE MANUAL



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Mark Levinson

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Woodbury, New York 11797

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Specifications

The correlation between published specifications and sonic quality is unreliable. A list of numbers reveals virtually nothing. All technical measurements must be subject to qualitative as well as quantitative interpretation.

Measurements of the Nº 27 yield excellent results by any standards. However, only those specifications that apply to the actual operation of the amplifier are included here.

- **Rated power:** 100 watts minimum continuous sine wave power into 8 ohms, with both channels driven from 20Hz to 20KHz with no more than 0.1% THD (FTC). 200 watts minimum continuous sine wave power into 4 ohms with both channels driven from 20Hz to 20KHz with no more than 0.2% THD (FTC).
- **Peak output voltage:** 48 volts @ rated line voltage @ 8 ohms
- **Frequency response:** (-3dB) 4Hz, 122KHz
- **Input impedance:** 50K ohms shunted by 1.5nF
- **Voltage gain:** 26dB
- **Power consumption:** Typically 175 watts @ idle, 400 watts @ rated power, 8 ohms
- **Overall dimensions:** See "Dimensions"
- **Shipping weight:** 85 lbs. (38.5 kg)
- **Connector complement:** Two Camac coaxial connectors
  Two XLR-type connectors
  Four five-way binding posts
  One IEC mains connector

For more information, consult your Mark Levinson retailer or:

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Signal connection

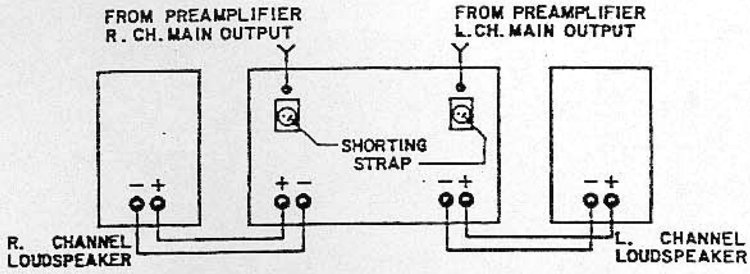
The № 27 can be operated in either single-ended or balanced mode. In each of these modes, the № 27 can be operated either normally (non-inverting) or inverting.

This manual describes the connections for single-ended normal (non-inverting), single-ended inverting, and balanced normal (non-inverting) operation. If you have questions about these or other methods of signal connection, see your Mark Levinson retailer.

Single-ended normal (non-inverting) operation

Connections for single-ended normal (non-inverting) operation: Typical audio systems require that the amplifier be of the non-inverting type. This means that the output signal of the amplifier will be in phase with the input signal.

Figure 2: Connections for single-ended normal (non-inverting) operation

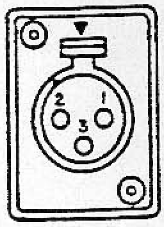


For this type of operation, connect the main outputs of the preamplifier to the appropriate (left and right channel) Camac inputs (non-inverting) on the rear panel of the № 27. Be sure that the shorting strap is inserted into the XLR-type connectors between pins 1 and 3 (refer to Figure 1 and Figure 2).

Single-ended inverting operation

Connections for single-ended inverting operation: Inverting operation should be used if a phase reversal is required. In this mode of operation, the output signal of the amplifier will be 180 degrees out of phase with the input signal. This may be required if one component in the system inverts the signal and absolute phase at the loudspeaker is desired. For inverting operation, the main output cables of the preamplifier must be connected to the XLR-type input connectors at the rear of the № 27. The pin assignments of these connectors are (refer to Figure 3):

Figure 3: Female input connector



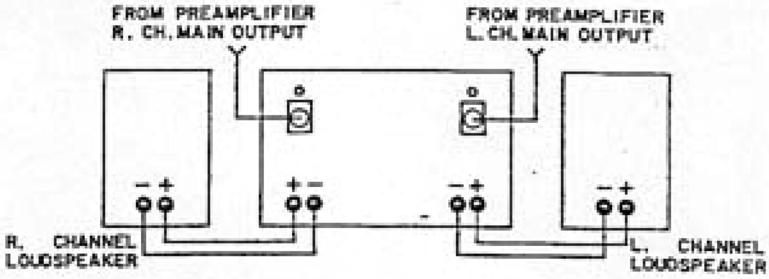
- Pin 1: Signal ground
- Pin 2: Signal "+" (Non-inverting)
- Pin 3: Signal "−" (Inverting)
- Connector ground lug: Chassis ground

Connect the XLR-type male line mount connector to the preamplifier main output cable so that signal "hot" (+) connects to Pin 3 and signal ground connects to Pin 1. Be sure to also connect Pin 2 to Pin 1 inside the XLR-type male line mount connector with a piece of copper buss wire (or similar material) at the amplifier end of the cable.

Note: If you prefer not to connect Pin 2 to Pin 1 inside the XLR-type male line mount connector, you may purchase pre-shorted Camac input connectors (Madrigal Part #65-0010-00-SP-00) from your Mark Levinson retailer. These parts should be inserted into each of the Camac inputs (non-inverting) on the rear panel of the Nº 27.

After completing the cables, connect the main outputs of the preamplifier to the appropriate (left and right channel) XLR-type input connectors on the rear panel of the Nº 27. Be sure to remove the shorting strap between Pins 1 and 3 before inserting the output cable connectors (refer to Figure 1 and Figure 4).

Figure 4: Connections for single-ended inverting operation

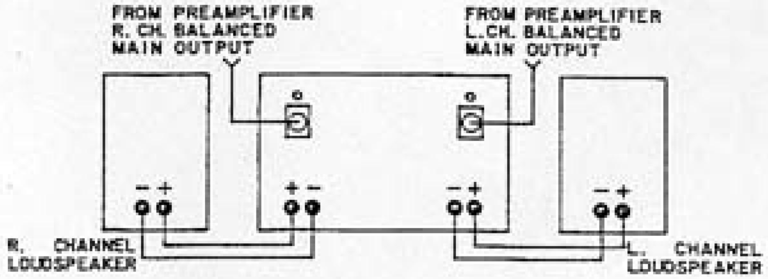

FROM PREAMPLIFIER
R. CH. MAIN OUTPUT
FROM PREAMPLIFIER
L. CH. MAIN OUTPUT
− +
+ −
− +
− +
R. CHANNEL
LOUDSPEAKER
L. CHANNEL
LOUDSPEAKER

Balanced normal (non-inverting) operation

Connections for balanced normal (non-inverting) operation: If your preamplifier is equipped with a balanced main output, it is advantageous to wire the Nº 27 for balanced operation, particularly if long cable lengths are required between the preamplifier and the Nº 27. Refer to Figure 3 for the pin assignments of the XLR-type input connectors at the rear of the Nº 27.

Connect the XLR-type male line mount connector to the preamplifier main output cable according to Figure 3, carefully observing pin number assignments. Refer to your preamplifier's operating manual to verify that the pin assignments of its output connector correspond to the diagram above. If they do not, wire the connector so that the appropriate output pin connects to the equivalent input pin. When complete, connect the main outputs of the preamplifier to the appropriate (left and right channel) XLR-type input connectors on the rear panel of the Nº 27. Be sure to remove the shorting strap between Pins 1 and 3 before inserting the output cable connectors. For proper balanced operation, no connector (pre-shorted or otherwise) should be inserted into the Camac inputs at the rear of the Nº 27 (refer to Figure 1 and Figure 5).

Figure 5: Connections for normal (non-inverting) balanced operation


FROM PREAMPLIFIER
R. CH. BALANCED
MAIN OUTPUT
FROM PREAMPLIFIER
L.CH. BALANCED
MAIN OUTPUT
− +
+ −
− +
− +
R. CHANNEL
LOUDSPEAKER
L. CHANNEL
LOUDSPEAKER

Speaker connections

Precautions

NEVER connect the Nº 27 output terminals to any device other than a loudspeaker.

NEVER short-circuit the amplifier output terminals.

NEVER connect the left channel output terminals to the right channel output terminals.

The Nº 27 is equipped with gold-plated, high-current, five-way binding posts for output termination to a loudspeaker system. To take full advantage of the sonic quality of the Nº 27, we recommend that high-quality speaker cable be used. Consult your Mark Levinson retailer for recommendations.

Connection methods

There are two recommended methods for connecting speaker cables to the outputs of the Nº 27. A high quality spade or hook-type lug, soldered to the cable, is preferred. We confidently recommend Madrigal binding post lugs, made of oxygen-free copper with gold-over-silver plating. These lugs are available for round cable (Madrigal Part #65-0901-70-00-00): see your Mark Levinson retailer for more information.

Figure 6: Spade and hook lugs

Spade Lug
Hook Lug

Many lug connectors are designed to be crimped onto the cable. However, soldering will ensure a better electrical connection.

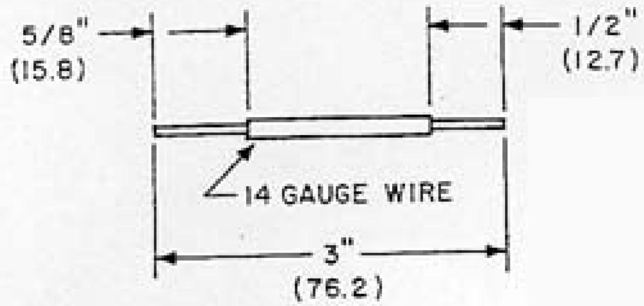
Note: If you have no experience in soldering, please contact your representative for assistance.

Pigtail connection

The "pigtail" is another method of connection which uses a short piece of 14-gauge wire soldered to the speaker cable. The other end of this 14-gauge wire is inserted through the hole in the five-way binding posts on the rear panel of the Nº 27.

1. Begin with 3" of 14-gauge copper wire.
2. Strip 5/8" of insulation from one end, and strip 1/2" of insulation from the opposite end (refer to Figure 7A).

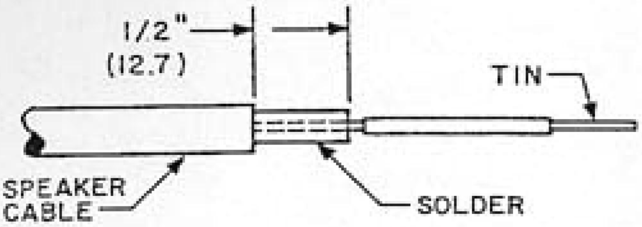
Figure 7A: Pigtail connection



3. Strip 1/2" of insulation from the speaker cable.

4. Gently slide the (5/8") bare end of the 14-gauge wire into the center of the bare speaker cable (refer to Figure 7B; be careful not to spread the individual wires of the speaker cable).

Figure 7B: Pigtail connection

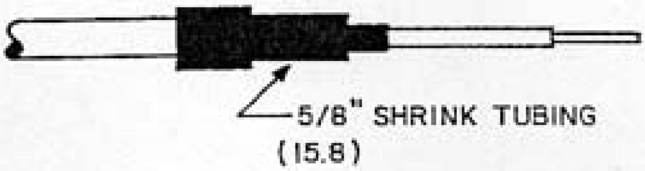


5. Solder this connection (refer to Figure 7B). A high-wattage soldering gun may be necessary to provide adequate heat.

6. Lightly "tin" the remaining (1/2") bare end of the 14-gauge wire.

7. Gently slide a 1" length of shrink tubing (5/8" diameter tubing for HF10C) over the connection and heat to shrink (refer to Figure 7C). Colored shrink tubing is available for polarity identification.

Figure 7C: Pigtail connection



8. Follow this procedure for the three remaining speaker connections.

This procedure may also be used for the speaker end of the cable, depending upon the type of speaker terminal.

Connecting the speakers

When the speaker cables are complete, connect the left channel " (positive or red) output post of the Nº 27 to the "+" (positive or red) input terminal of the appropriate loudspeaker. Connect the left channel "–" (negative or black) output post of the Nº 27 to the "–" (negative or black) input terminal of the appropriate loudspeaker (refer to Figure 1 and Figure 2). Repeat this procedure for the right channel.

Power connection

Connecting the AC power cord

After your loudspeaker connections have been made, apply power to your preamplifier and allow it to stabilize (Mark Levinson preamplifiers, for example, require approximately one minute to stabilize).

Connect the AC power cord (included in the accessory pack) to the AC connector on the rear panel of the Nº 27, then to the AC mains outlet (refer to Figure 1).

The Nº 27 may now be turned on.

Bridged operation

When greater power output is desired, the Nº 27 may be bridged for monophonic operation into load impedances of at least 2 ohms.

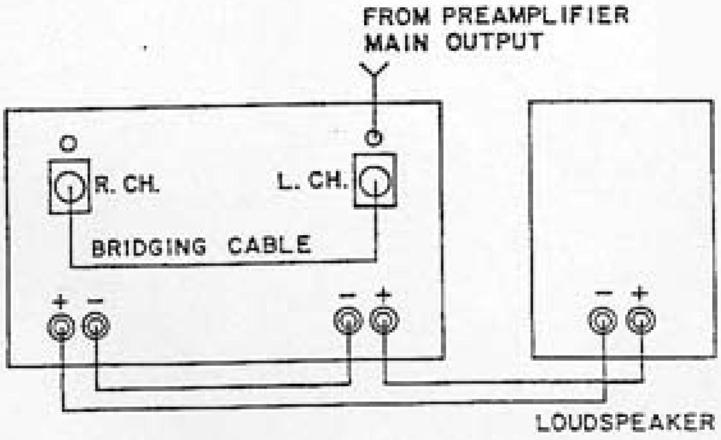
> **Note:** Make sure the loudspeaker is rated to handle extremely high power levels. For example, a bridged Nº 27 driving an 8-ohm loudspeaker is capable of delivering 400 watts RMS.

When planning to use Nº 27 amplifiers in the bridged mode with loudspeakers that are biamp-able, we strongly recommend purchasing a high quality electronic crossover (such as the Mark Levinson LNC-2) and operating in the biamp mode.

Connections for bridged operation

1. Connect the appropriate channel of the preamplifier's main output to the left channel Camac input (non-inverting) on the rear panel of the Nº 27 (refer to Figure 8).

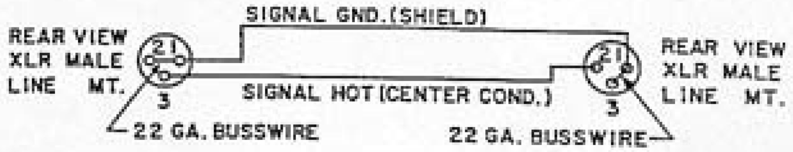
Figure 8: Connections for bridged operation



Bridging cables

2. Connect the bridging cable between the left and right channel XLR-type input connectors, taking care to insert the correct cable end into its designated channel (refer to Figure 8). This cable can be assembled as shown in Figure 9, or obtained through your Mark Levinson retailer as part of a № 27 Bridging Kit (Madrigal Part #76-4330-00-00-00).

Figure 9: Bridging cable


SIGNAL GND.(SHIELD)
REAR VIEW
XLR MALE
LINE MT.
2
1
3
SIGNAL HOT (CENTER COND.)
22 GA. BUSSWIRE
REAR VIEW
XLR MALE
LINE MT.
2
1
3
22 GA. BUSSWIRE

Note: If assembling the bridging cable, be sure to use high quality audio interconnect cable (such as Madrigal HPC cable).

3. Connect the shortest possible length of heavy-gauge, high quality speaker cable (such as Madrigal CPC cable) between the left and right channel "–" (negative or black) output posts of the № 27 (refer to figure 8).

4. Connect the left channel "+" (positive or red) output post of the № 27 to the "+" (positive or red) input terminal of the appropriate loudspeaker. Connect the right channel "+" (positive or red) output post of the № 27 to the "–" (negative or black) input terminal of the same loudspeaker (refer to Figure 8).

5. Repeat this procedure for the other № 27 to be bridged.

Circuit description

Unregulated power supplies

The Nº 27 uses two completely independent power supplies, one per channel. Each of these supplies, in turn, consists of two power supplies:

- **High-current output stage supply:** Composed of a custom-made 729VA toroidal power transformer, a 35-ampere bridge rectifier, and two 45,000µf filter capacitors. Each of the filter capacitors is further bypassed on the audio printed circuit board with switch-mode electrolytic and film-type capacitors.

- **Low-current pre-regulated supply:** Consists of two separate 34VA secondary windings from the toroidal power transformer, a discrete bridge rectifier, and two 1900µf filter capacitors which are further bypassed on the audio printed circuit board with switch-mode electrolytic and film-type capacitors.

Regulated power supplies

Each low-current pre-regulated supply is further conditioned by a separate electronic regulation circuit: This circuit consists of three common emitter amplifiers providing voltage and current gain for the required 65V, 118MA output. On-board voltage sensing provides negative feedback error correction utilizing operational amplifier techniques. The regulating system is completely discrete, independent-tracking, and prevents the resulting DC voltage rails from fluctuating due to severe current demands from the output stage or changes in the AC mains voltage. In addition to the substantial amount of ripple and AC mains interference rejection this system provides, the regulated DC voltage rails are further filtered by switch-mode electrolytic capacitors bypassed with various film-type capacitors. These stable, noise-free, and ripple-free DC voltage rails are used to power the highly sensitive voltage gain stages of the Nº 27.

Voltage gain stage

The voltage gain stage consists of a differential amplifier with a cascode. This stage drives a second differential amplifier with a cascode and a current mirror. Discrete current sources are used throughout. The current mirror converts from balanced to ground (differential) to unbalanced to ground while maintaining push-pull operation. An advanced circuit controls the clipping characteristics of these stages by reducing the amount of harmonics generated. Also incorporated is circuitry which prevents transients produced during turn-on/turn-off from reaching the loudspeakers. To optimize linear performance, all voltage gain and driver stages maintain Class A operation at all levels.

Driver stage

The driver stage consists of a complementary emitter follower driving a second complementary parallel emitter follower.

Output stage

The output stage consists of four parallel complementary push-pull emitter follower pairs.

Protection

The Nº 27 combines a comprehensive fusing system, electronic protection circuitry, and a custom-mode relay-trip on/off switch to protect itself and your loudspeakers if a malfunction occurs. These systems constantly monitor the following operating parameters:

- AC mains current
- Amplifier temperature
- DC offset level
- Power dissipation in the output stage, phase angle dependent
- Short circuit at the output

Additional

The Nº 27 Dual Monaural Power Amplifier is capable of revealing extremely subtle nuances and details in recorded music. To maximize the performance of your audio system, be sure to carefully set up and optimize all associated components and interconnections in the reproduction chain. Your Mark Levinson retailer, through experience and highly specialized training in the art of music reproduction, can provide valuable advice and assistance in creating a music system able to evoke emotional pleasure through the accurate reproduction of a musical event.

NO.27 THEORY OF OPERATION

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NO. 27 THEORY OF OPERATION: AC MAINS CONDITIONING, TRANSFORMER WIRING

Back panel fused AC mains is filtered common-mode and differentially by C1, C2 and C4 as it enters VB-5 board. Two separate anti-buzz circuits (one for line, one for neutral) help to reduce core saturation caused by asymmetrical power line conditions.

Both anti-buzz circuits operate identically. Line-side anti-buzz circuit incorporates a high current capacity bridge rectifier (AB1) to provide a two-diode conduction path in either direction. Diode turn-on and turn-off characteristics are filtered by a non-polarized electrolytic capacitor (C6, R5 and C8) and two parallel resistors (R6 and R7).

Turn-on inrush current is limited by the parallel combination of R8, R9 and R10, in series with primaries of T1 and T2. Limiting resistors are shunted by a high-current relay after turn-on for normal amplifier operation.

At turn-on, a 20V RMS primary winding of T1 and T2 is rectified by D1, D2, D5 and D6 and filtered by C14. C25 will charge through Q1's base and R13, forcing Q1 into saturation. As the exponential voltage charge on C25 reaches the zener voltage of D11, base current decreases and Q1 comes out of saturation. SR1's coil is energized as Q1's Vce rises and R8,R9 and R10 are shorted during normal amplifier operation.

NO.27 THEORY OF OPERATION: AUDIO AMPLIFICATION

OVERVIEW

Audio signals are processed through two cascaded voltage gain stages and three current gain stages. A bipolar cascoded differential input stage drives a second bipolar cascoded differential stage where balanced to single-ended signal conversion is accomplished via a current mirror. Two driver stages provide current gain and isolation while controlling a Class AB output stage.

VOLTAGE GAIN STAGE ONE

The first voltage gain stage consists of a bipolar cascoded differential amplifier with precision current source and sink. Q8, Q10, R26, R27, R29 and C10 comprise a typical precision current sink. Vbe of Darlington transistor Q10 is impressed across R27 to set Q8's emitter current at 2.4 mA (neglecting Q10's base current). Collector current for Q10 is set by R29 (neglecting Q8's base current). R26 is placed in series with Q8's collector to increase current sink impedance and lower power dissipation of Q8. Assuming Q8 collector current approximately equal to emitter current, total current for the first stage is 2.4 mA. 800 uA is sourced by Q7 to maintain bias voltage (through D8,D9 and R25) and provide base current for Q3 and Q11, the common-base pair of the differential cascode. The remaining 1.6 mA splits equally to provide quiescent emitter currents for Q6a and Q6b, a supermatch pair configured as a differential common emitter amplifier. Provision is made for a DCO adjust trimpot, R21 (not installed), to slightly alter the balance of collector currents to compensate for bias current imbalances in subsequent stages. Diodes D1, D2, D3, D4, D5 and D34 maintain sufficient DC voltage under all conditions for proper second stage current source operation. Open loop differential gain of the first stage is set by R15/R16, or 29.2 dB.

VOLTAGE GAIN STAGE TWO

The second voltage gain stage is comprised of a cascoded differential stage with current mirror for conversion to single-ended output. Total current for the second stage is 70 mA and is sourced by Q15. 10 mA is sunk by Q16 to provide base current for common base amplifiers Q13 and Q19 and maintain bias voltage (through D11, D12, D13 and R44) for bootstrap cascode operation. The remaining 60 mA splits equally to provide quiescent emitter currents for differential amplifier transistors Q12 and Q22. Zener diode D10 sets Q13's base-to-collector voltage close to Q19's base-to-collector voltage at quiescence. A current mirror formed by Q14, R39, Q21 and R51 force Q20's collector current equal to Q13's collector current. At proper quiescent operation, collector current sourced by common base amplifier Q19 to ground, bias and driver stages equals collector current sunk from ground, bias and driver stages by common base amplifier Q20. Open loop gain for the second stage is set by R49/R48, or 50.4 dB.

BIAS AND DRIVER STAGES

Bias voltage for drivers and outputs is provided by Vbe multipliers Q25 and Q26 and is adjusted by trimpot R65. Vbe Q25 + Vbe Q26 set voltage across R65 and R67, and by varying R65 current through R66, R67, R65 and R68 can be adjusted to provide the proper bias voltage between the bases of Q27 and Q28. Predrivers Q27 and Q28 operate Class A with a quiescent emitter current of 15 mA, set by R71. Drivers Q29 and Q30 operate Class A at a quiescent emitter current of 15 mA, set by R77.

OUTPUT STAGE

Class AB operation of the amplifier at rated power is accomplished with four paralleled complimentary outputs. Quiescent emitter current for each of these emitter follower amplifiers is 40 mA, set by individual emitter resistors plus master emitter resistors. R81, R82, R85, R86, R89, R90, R93 and R96 provide local feedback for each output device, while R122 II R94 and R123 II R95 comprise master emitter resistors for each output bank and provide overall stage feedback.

NO.27 THEORY OF OPERATION: SIGNAL LIMITING

OVERVIEW

Audio signals processed by the amplifier are limited in several ways to prevent damage to the amplifier and speaker load. Soft-clip circuitry resident on the audio channel limits signal peaks into all loads to avoid hard saturation of second stage, drivers and outputs. Diode clamps limit differential voltages within the amplifier. V-I limiting circuitry on OL-3 cards protects output devices from excessive power dissipation when driving very low or reactive loads.

SOFT CLIP CIRCUIT

Voltage limiting of drive lines is performed by Q23 and Q24. Base voltages for these devices are established by the resistor divider network of R62-R63-R64. Emitter current for Q23 and Q24 is set by R60 and R61. As unregulated rails sag due to current demands of the load, these voltages will adjust accordingly. When drive lines exceed these predetermined voltages, D14, D15 and D16 or D17, D18 and D19 will begin to conduct. Multiple breakpoints set by these diodes shape the limited drivelines before hard saturation of second stage, drivers or outputs can occur. Harsh diode turn-on characteristics are softened by paralled resistors. Soft clip circuit is the primary limiting circuit when driving loads as low as 2 ohms.

VI LIMIT CIRCUIT

When driving low impedance capacitive or inductive loads, the phase relation between output voltage and output current can significantly increase the power dissipation of output devices. If a complex load requires substantial current and little voltage simultaneously (a condition not demanded by a purely resistive load), output devices must provide current while absorbing voltage. The VI limit circuit, located on the OL-3 card, monitors both output current (by sensing the voltage drop across a master emitter resistor, R94 II R122 or R95 II R123) and output voltage (by comparing the voltage level of the amplifier side of the master emitter resistor to output ground).

Voltage across each output bank's master emitter resistor appears between pin 3 (PNP master emitter) or pin 4 (NPN master emitter) of Molex connector and the +Output binding post. The NPN output bank's master emitter resistor voltage is divided by R3 and the parallel combination of R7, C1 and R11. A portion of the master emitter's voltage is therefore available at Q3's base. C1 integrates this voltage so that current transients do not trigger VI limiting. Current through R18 and D17 is determined by the master emitter's voltage relative to output ground. This current will deplete drive available to Q3's base and prevent VI limit action.

When enough current is available to Q3's base despite the opposing action of the two sensing networks, Q3 will begin to conduct, forcing current into the base of Q1. Q1's collector current will increase conduction of Q3 and regenerative feedback will saturate Q1 and Q3. As the voltage at D13's cathode drops, diodes D3, D5, D7, D9 and D11 will forward bias, limiting the voltage swing at the audio channel's drive line, tied to Molex pin 7, and divert current from driver transistor bases. Because Q1 and Q3 form a discrete version of an SCR, the circuit will exhibit thermal sensitivity and limiting action hysteresis typical of a regenerative configuration.

DIFFERENTIAL INPUT VOLTAGE LIMITING

D6 and D7, located on the audio channel, limit differential input voltage swings to one diode drop in either direction. Normal operational amplifier action will keep differential voltages close to zero, but intervention of soft clip or VI limiting will cause conduction of these diodes to prevent saturation of first stage. D45, D46, D47 and D48 limit second stage differential voltage input swings to two diode drops in either direction. In normal operation, potential between bases of Q12 and Q22 is very small, but intervention of soft clip or VI limiting will cause conduction of these diodes.

NO. 27 THEORY OF OPERATION: SIGNAL INPUT, FREQUENCY RESPONSE & CLOSED-LOOP GAIN

Audio signals enter the amplifier via a Camac connector (for single-ended, non-inverting operation) or a three-pin Neutrik connector (for single-ended, non-inverting or inverting operation, or balanced operation). A pi-type RC network incorporating ferrite beads located on the OL-3 card attenuates high-frequency signal contamination prior to connection to the audio channel via a shielded, twisted cable.

DC blocking capacitors C1, C2, C4 and C5 prevent the amplification of DC levels at the audio channel's input. DC offset is minimized through the use of an LM394 supermatch pair input differential amplifier and by its approximately equal DC base-to-ground impedances of R9 and R38 which allows cancellation of input offset voltages due to base bias currents.

NON-INVERTING INPUT

Low frequency -3 dB point for non-inverting input is set with pole created by DC blocking capacitors C4 and C5 and R8 and R9. High frequency -3 dB point is set primarily by C6, R8 and R9. Non-inverting system gain at midband audio frequencies is {R9/R8+R9}X{(R36||R38/R22)+1} or 26.5 dB.

INVERTING INPUT

Low frequency -3dB point for inverting input is set with pole created by DC blocking capacitors C1 and C2 and R5. High-frequency -3dB point is set primarily by R5 and C3. Inverting system gain at midband audio frequencies is -(R36||R38/R22) or -26.5 dB.

NO.27 THEORY OF OPERATION: BUFFER

To accomodate the possibility of balanced inputs in a conventional operational amplifier configuration, a buffer circuit is included to isolate the inverting input from system feedback to the differential amplifier. Two pairs of complimentary emitter followers accomplish current gain for the buffer. Collector current for Q1 is set by constant current source CR1 at 1.6mA. Collector current for Q2 is set by constant current source CR2 at 1.6mA. Assuming negligible base currents for all buffer devices and no input offset voltage, VR10=VR17 and VR11=VR18. Therefore, IR17=IR10{R10/R17} or 4.8mA. Collector current of Q4 is ICQ2 + IR17 or 6.4mA and collector current of Q5 is ICQ1 + IR18 or 6.4 mA, for a collector current bias ratio of 4.

NO.27 THEORY OF OPERATION: ANTI-THUMP

During turn-on and turn-off, transients are minimized by clamping amplifier drive lines to ground. Clamping, and comparator and timing circuitry to accomplish this, is located on the AT-2 daughter card.

COMPARATOR

Comparator Q49 monitors -VReg and develops the appropriate voltage across its collector load resistor, R125, to control clamping action. With Q49's base held to -12V by D53, D55 in zener breakdown at 47V, and voltage across R129 setting emitter current, Q49 remains in saturation during normal amplifier operation. If -VReg falls below the zener threshold of D53 + D55, emitter current through R129 will cease. As Q49 stops conducting, voltage across R125 drops to zero.

Q48, an N-channel JFET, is switched by Q49 to control the voltage at the junction of R126 and R128. Q48's Vgs is Q49's collector-to-ground voltage. During normal operation, Q48's Vgs is at -12V, well below specified gate-source cutoff voltage. Drain current at this time is virtually zero. Diode D52 is in zener breakdown and voltage at the junction of R126 and R127 is held at 12 V. Since current through R126 is virtually zero, voltage at the junction of R126 and R128 is approximately 12V. When Q49 is not conducting (at turn-on or after turn-off), Q48's Vgs falls to 0V, Q48 saturates, and the junction of R126 and R128 is brought to ground.

TIMING

C55 will always charge to the voltage at the junction of R126 and R128. When Q48 is in cutoff (after turn-on and during normal amplifier operation), C55 charges slowly through R124 and R128 to +12V. When Q48 saturates (at turn-on or after turn-off), C55 discharges quickly through D51, R128 and the drain of Q48 to ground. Charge on C55 is applied to the gate of Q47.

CLAMPING

Amplifier drive lines are clamped to ground during power-up and power-down by saturated bipolar transistors Q45 and Q46 and their associated steering diodes D49 and D50. Saturation of these transistors is controlled by MOSFET Q47. When the charge on C55 is near 0V, Q47, an enhancement-mode device, does not conduct and bases of Q45 and Q46 are biased through R118 and R120. As C55 charges toward +12V, Q47 conducts heavily, shorting the bases of Q45 and Q46 together and diverting base current through its channel. With Q45 and Q46 now off, collector-diode junctions are pulled to power supply rails to prevent interference with drive lines during normal operation.

NO.27 THEORY OF OPERATION:REGULATOR

Voltage gain stages are powered by regulated + and - 65V supplies. DC rectification is performed by a discrete full wave bridge located on the VB-5 PC board. Two 1900uF capacitors clamped to the chassis provide filtering before the unregulated voltages are brought to the audio channel's two separate, non-tracking regulators. Since regulators are complimentary but identical, operation of the positive regulator will be described in detail. A reference voltage is set by 36V zener diode, D24, and filtered by C40. Zener current is comprised of Q39's emitter current and current through R104 from the regulated output. Q39's base is connected to the wiper of R102, part of resistor divider R98, R102 and R99. Regulator gain {1 + (R98 + R102a)/ (R102b + R99)} can be varied by adjusting R102. Three common emitter amplifiers, Q39, Q41 and Q43, provide voltage and current gain for the required 65V, 118mA output.

D32 and D33 derive 12V supplies from the regulated output to power the inverting input buffer.

Several forms of protection are incorporated within the regulator. D22 limits reverse voltages at Q39's base-emitter junction, particularly during power-up, brownout and power-down. D26 prevents forward biasing base-collector junctions of Q41 and Q43 during similar conditions. D28 prevents damage to Q43 and in conjuction with D30 limits reverse voltages at the unregulated input. Current limiting is accomplished by D45, D46, D47 and D48 by shunting additional drive away from Q43's base should regulator output current (approximately equal to current through R114) cause Vbe Q43 + VR114 forward bias this diode string.

Under normal operating conditions, regulators source and sink approximately 138 mA.

NO. 27 THEORY OF OPERATION: OVERCURRENT, DC AND THERMAL PROTECTION

OVERVIEW

Three catastrophic conditions will interrupt amplifier operation. If excessive current is drawn by the amplifier, user-accessible fuses on the rear panel will open. A second set of fuses of higher current rating are located on the VB-5 PC Board and will open if panel mount fuses are defeated or in the case of extreme overcurrent conditions.

If either DC at either channel's output or excessive heat dissipation by any of the amplifier's heatsinks occurs, sensing circuits located on the amplifier's two OL-3 boards will signal an SCR located on the VB-5 board to energize a coil in the main on-off switch and shut off the amplifier. The sensing circuitry is powered by each channel's +V unreg via pin 5 of a seven-pin Molex connector.

DC SENSING

If DC is present at the amplifier's output terminals, C8 will charge through R20. A positive voltage on C8 is steered by D20 and limited by D23. A negative voltage on C8 is steered by D21 and limited by D22. In either case, Q5 conducts and turns Q6 on. A positive-going voltage will appear at pin 2 of Molex connector, current limited by R29.

THERMAL SENSING

An 80 degree Celsius sensor is located on each of four heatsinks of the amplifier. The sensor is a normally closed switch; if excessive temperatures exist the sensor opens. Two sensors are daisy-chained for each channel; they normally hold pin 6 of Molex connector at ground. If either opens, R23 pulls the thermal sense line high and D19 conducts, turning on Q5. Again a positive-going voltage appears at pin 2 of Molex connector.

COIL TRIP CIRCUITRY

DC and thermal fault conditions cause a positive-going voltage to be sent to the VB-5 board via 22 awg wire. Because each sensing circuit operates off its channel's independent power supply, OPT1 and OPT2 are used to couple these signals to a single trip circuit powered by +V Unreg of the right channel. Optocoupler and gate drive circuitry are powered by a 12 volt supply derived by zener diode D27 from this rail. When triggered, SCR1 will conduct, energizing a coil in on/off switch which turns the amplifier off. If either OPT1 or OPT2 are energized, the cathode of D24 or D25 is brought low, allowing base current through R15 to turn on Q2. Collector current of Q2 supplies gate drive for SCR1 through R17.

NO. 27 THEORY OF OPERATION: AC MAINS CONDITIONING, TRANSFORMER WIRING

Back panel fused AC mains is filtered common-mode and differentially by C1, C2 and C4 as it enters VB-5 board. Two separate anti-buzz circuits (one for line, one for neutral) help to reduce core saturation caused by asymmetrical power line conditions.

Both anti-buzz circuits operate identically. Line-side anti-buzz circuit incorporates a high current capacity bridge rectifier (AB1) to provide a two-diode conduction path in either direction. Diode turn-on and turn-off characteristics are filtered by a non-polarized electrolytic capacitor (C6, R5 and C8) and two parallel resistors (R6 and R7).

Turn-on inrush current is limited by the parallel combination of R8, R9 and R10, in series with primaries of T1 and T2. Limiting resistors are shunted by a high-current relay after turn-on for normal amplifier operation.

At turn-on, a 20V RMS primary winding of T1 and T2 is rectified by D1, D2, D5 and D6 and filtered by C14. C25 will charge through Q1's base and R13, forcing Q1 into saturation. As the exponential voltage charge on C25 reaches the zener voltage of D11, base current decreases and Q1 comes out of saturation. SR1's coil is energized as Q1's Vce rises and R8,R9 and R10 are shorted during normal amplifier operation.

NO. 27 THEORY OF OPERATION: OVERCURRENT, DC AND THERMAL PROTECTION

OVERVIEW

Three catastrophic conditions will interrupt amplifier operation. If excessive current is drawn by the amplifier, user-accessible fuses on the rear panel will open. A second set of fuses of higher current rating are located on the VB-5 PC Board and will open if panel mount fuses are defeated or in the case of extreme overcurrent conditions.

If either DC at either channel's output or excessive heat dissipation by any of the amplifier's heatsinks occurs, sensing circuits located on the amplifier's two OL-3 boards will signal an SCR located on the VB-5 board to energize a coil in the main on-off switch and shut off the amplifier. The sensing circuitry is powered by each channel's +V unreg via pin 5 of a seven-pin Molex connector.

DC SENSING

If DC is present at the amplifier's output terminals, C8 will charge through R20. A positive voltage on C8 is steered by D20 and limited by D23. A negative voltage on C8 is steered by D21 and limited by D22. In either case, Q5 conducts and turns Q6 on. A positive-going voltage will appear at pin 2 of Molex connector, current limited by R29.

THERMAL SENSING

An 80 degree Celsius sensor is located on each of four heatsinks of the amplifier. The sensor is a normally closed switch; if excessive temperatures exist the sensor opens. Two sensors are daisy-chained for each channel; they normally hold pin 6 of Molex connector at ground. If either opens, R23 pulls the thermal sense line high and D19 conducts, turning on Q5. Again a positive-going voltage appears at pin 2 of Molex connector.

COIL TRIP CIRCUITRY

DC and thermal fault conditions cause a positive-going voltage to be sent to the VB-5 board via 22 awg wire. Because each sensing circuit operates off its channel's independent power supply, OPT1 and OPT2 are used to couple these signals to a single trip circuit powered by +V Unreg of the right channel. Optocoupler and gate drive circuitry are powered by a 12 volt supply derived by zener diode D27 from this rail. When triggered, SCR1 will conduct, energizing a coil in on/off switch which turns the amplifier off. If either OPT1 or OPT2 are energized, the cathode of D24 or D25 is brought low, allowing base current through R15 to turn on Q2. Collector current of Q2 supplies gate drive for SCR1 through R17.

NO.27 THEORY OF OPERATION: SIGNAL LIMITING

VI LIMIT CIRCUIT

When driving low impedance capacitive or inductive loads, the phase relation between output voltage and output current can significantly increase the power dissipation of output devices. If a complex load requires substantial current and little voltage simultaneously (a condition not demanded by a purely resistive load), output devices must provide current while absorbing voltage. The VI limit circuit, located on the OL-3 card, monitors both output current (by sensing the voltage drop across a master emitter resistor, R94 II R122 or R95 II R123) and output voltage (by comparing the voltage level of the amplifier side of the master emitter resistor to output ground).

Voltage across each output bank's master emitter resistor appears between pin 3 (PNP master emitter) or pin 4 (NPN master emitter) of Molex connector and the +Output binding post. The NPN output bank's master emitter resistor voltage is divided by R3 and the parallel combination of R7, C1 and R11. A portion of the master emitter's voltage is therefore available at Q3's base. C1 integrates this voltage so that current transients do not trigger VI limiting. Current through R18 and D17 is determined by the master emitter's voltage relative to output ground. This current will deplete drive available to Q3's base and prevent VI limit action.

GrowthPower MADRIGAL AUDIO LABORATORIES, INC. SUN, JAN 24, 1993, 9:31 AM

INDENTED ENGINEERING BILL OF MATERIAL FOR ALL REVS FOR SELECTED PARTS PAGE 1

Part Number MLC273 ML NO27 120

Revision Level: Engineering Status: AN Comment: 763206001000

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
1	10				LA2705		ML 27 ASSY FI 120V	1	EA	S		
2	10				420083		SCREW 2367 THUMBSCREW	8	EA	P		
2	20				420101		SCREW SHCS 8-32X.625	4	EA	P		
2	30				420121		SCREW BUTTON HD HEX CAP 6-32 X .250" SS	24	EA	P		
2	40				420198		SCREW BHSCS 4-40 X .25 SS	4	EA	P		
2	50				350064		FUSE 10 AMP	2	EA	P		
2	60				500197J		METAL XLR STRAP COMPLETE	2	EA	P		
3	10				500197		METAL XLR STRAP RAW	1	EA	P		
2	70				500466J		METAL NO27 H/S COVER COMP.	4	EA	P		
3	10				500466		METAL NO27 H/S COVER RAW	1	EA	P		
2	80				500467J		METAL NO27 TOP PLATE COMP.	1	EA	P		
3	10				500467C		METAL NO27 TOP PLATE BR+BU	1	EA	P		
4	10				500467		METAL NO27 TOP PLATE RAW	1	EA	P		
2	90				500468J		METAL NO27 BOT. PLATE COMP.	1	EA	P		
3	10				500468C		METAL NO27 BOT. PLATE BR+BU	1	EA	P		
4	10				500468		METAL NO27 BOT. PLATE RAW	1	EA	P		
2	100			12/29/92	500476J		METAL NO27 XFMR COVER COMP.	2	EA	P		
3	10				500476		METAL NO27 XFMR COVER RAW	1	EA	P		
2	110				480106		LABEL SER# NO.27	1	EA	P		
2	120				430025		TAPE FOAM SINGLE SIDED	36	IN	P		
2	130				430026		DOT INDICATOR .0930D RED	1	EA	P		
2	140				430030		FEET CABINET LG BLACK	4	EA	P		
2	150				430033		GROMMET U-CHANNEL .052" NYLON BLACK	39	IN	P		
2	160				LA2711		ML 27 A&T CH FINISHED	1	EA	S		
3	10				580092		PCB ML-10 LED BD	1	EA	P		
3	20				440016		TUBING SHRK .125 BLACK .5L	14	EA	P		
3	30				420084		SCREW SLOTTED 10-32 X .375 BRASS	4	EA	P		
3	40				420089		WASHER #10 ITLW	4	EA	P		
3	50				420095		WASHER #4 ITLW SS	1	EA	P		
3	60				420097		SCREW BINDER HD. 4-40X.50	1	EA	P		
3	65		3/18/91		420101		SCREW SHCS 8-32X.625	8	EA	P		
3	70				420116		WASHER #10 ITLW	9	EA	P		
3	80				420119		SCREW SHCS 10-32 X 1.0"	4	EA	P		
3	90				420120		WASHER #6 ITLW BRONZE	12	EA	P		
3	100				420174		SCREW BHMS 6-32X.375 BRASS	6	EA	P		
3	110				460033		HDWRE.PLSTIC NYLON SPACER .265L	1	EA	P		
3	120				500465J		METAL NO27 FRONT HANDLE COMP	2	EA	P		
4	10				500465C		METAL NO27 FRONT HANDLE BUFFED	1	EA	P		
5	10				500465		METAL NO27 FRONT HANDLE RAW	1	EA	P		
3	130				500469J		METAL NO27 FRONT PLATE COMP.	1	EA	P		
4	10				500469C		METAL NO27 FRONT PLATE BUFFED	1	EA	P		
5	10				500469B		METAL NO27 FRONT PLATE ENGRAVER	1	EA	P		
6	10				500469A		METAL NO27 FRONT PLATE BRUSHED	1	EA	P		
7	10				500469		METAL NO27 FRONT PLATE RAW	1	EA	P		
3	140				710003		LED FLUSH MT RED	1	EA	P		
3	150				430031		FEET BUMPER ADHESIVE BACK BLACK	4	EA	P		
3	160				LA2704		ML 27 A&T H/S AC3	2	EA	S		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
4	10				720026		TRANSISTOR TIP122	1	EA	P		
4	20				720028		TRANSISTOR TIP127	1	EA	P		
4	30				720067A		TRANSISTOR MJ15024 SORTED A	4	EA	P		
5	10				720067		TRANSISTOR MJ15024 UNSORTED	1	EA	P		
4	40				720068A		TRANSISTOR MJ15025 SORTED A	4	EA	P		
5	10				720068		TRANSISTOR MJ15025 UNSORTED	1	EA	P		
4	50				720069		TRANSISTOR MJE15030 UNSORTED	1	EA	P		
4	60				720069A		TRANSISTOR MJE15030 SORTED A	3	EA	P		
5	10				720069		TRANSISTOR MJE15030 UNSORTED	1	EA	P		
4	70				720070		TRANSISTOR MJE15031 UNSORTED	1	EA	P		
4	80				720070A		TRANSISTOR MJE15031 SORTED A	3	EA	P		
5	10				720070		TRANSISTOR MJE15031 UNSORTED	1	EA	P		
4	90				300052		WIRE HOOK-UP 22AWG ORANGE	13.7500	IN	P		
4	100				300053		WIRE HOOK-UP 22AWG RED	16.2500	IN	P		
4	110				300055		WIRE HOOK-UP 22AWG YELLOW	15.5000	IN	P		
4	120				300056		WIRE HOOK-UP 22AWG GREEN	9	IN	P		
4	130				300058		WIRE HOOK-UP 22AWG BROWN	27.2500	IN	P		
4	140				300059		WIRE HOOK-UP 22AWG VIOLET	9	IN	P		
4	150				300060		WIRE HOOK-UP 22AWG WHITE	14.7500	IN	P		
4	160				300061		WIRE HOOK-UP 22AWG BLACK TEFLON	25.3800	IN	P		
4	170				300071		WIRE HOOK-UP 26AWG BLACK	24	IN	P		
4	180				440022		TUBING SHRK .062 BLACK .5L	4	EA	P		
4	190				400073		ELEC HDWR FASTON .250 RED FEMALE 18-22	1	EA	P		
4	210				420103		ELEC HDWRE SOLDER CUP PCPIN 18.STRIP MM	1	EA	P		
4	220				400104		ELEC HDWRE SOLDER CUP PCPIN 12/STRIP MM	1	EA	P		
4	230				420101		SCREW SHCS 8-32X.625	4	EA	P		
4	240				420120		WASHER #6 ITLW BRONZE	12	EA	P		
4	250				420129		SCREW SLOTTED 4-40 X .250 BRASS	14	EA	P		
4	260				420135		SCREW BHMS 6-32X.625L BRASS	12	EA	P		
4	270			9/30/92	420186		SCREW BHMS 4-40X.375 BRASS	8	EA	P		
4	280				420220		STANDOFF 8-32 X 1/4 X 1.50"L HEX M-F	4	EA	P		
4	290				460017		HDWRE PLSTC NYLON TYWRAP 4"	4	EA	P		
4	300				460032		HDWRE.PLSTIC SHLDR.WASHER TO220 NO.4 BLK	14	EA	P		
4	310				460040		HDWRE.PLSTIC NYLON SPCER.063IDX.156X.640	3	EA	P		
4	320				460044		HDWRE.PLSTIC DELRIN SHOULDER WASHER	12	EA	P		
4	330				350075		THERMAL SENSOR 80C	2	EA	P		
4	340				330173		CONN LNMT CRIMP TERMINAL KK 18-24AWG	7	EA	P		
4	350				330183		CONN LNMT 7PIN TERMINAL HOUSING	1	EA	P		
4	360				400022J		ELEC HDWRE INSULATOR FR-4 NO.27 AUDIO CH	1	EA	P		
4	370				400061		ELEC HDWRE INSULATOR TO-3 MICA	8	EA	P		
4	380				400062		ELEC HDWRE INSULATOR TO-220 MICA	10	EA	P		
4	390				500459J		METAL NO27 H/S COMP	2	EA	P		
4	400				500460J		METAL NO27 CHASSIS BAR COMP.	2	EA	P		
4	420				LA2703		ML 27 A&T PCBD AC3	1	EA	S		
5	10				150002		TRIMPOT 200R RT ANGLE 201	1	EA	P		
5	20				150003		TRIMPOT 2K RT ANGLE 202	2	EA	P		
5	30				220020		CAP 10U 160V MET PPRO 5% 10UF RAD	1	EA	P		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
5	40				220024		CAP 2U2 160V MET PPRO 5% 2.2UF RAD	2	EA	P		
5	50				220031		CAP 330N 160V MET PPRO 10% .33UF RAD	7	EA	P		
5	60				220038		CAP 100N 250V MET PPRO 10% .1UF RAD	1	EA	P		
5	70				220040		CAP 680N 160V MET PPRO 10% .68UF RAD	3	EA	P		
5	80				200013		CAP 68U 25V RADIAL LYTIC -10%, +50%	2	EA	P		
5	90				200050		CAP 22U 63V LYTIC RAD PCMT	2	EA	P		
5	100				200063		CAP 680U 75V LYTIC RAD PCMT 680UF	4	EA	P		
5	110				700008		DIODE CR160 1.6MA CURRENT DIODE	2	EA	P		
5	120				700022		DIODE 1N914B	28	EA	P		
5	130				700023		DIODE 1N963B 500MW 12V 5% ZENER	2	EA	P		
5	140				720004		TRANSISTOR 2N6718 UNSORTED	2	EA	P		
5	150				720004A		TRANSISTOR 2N6718 SORTED A	2	EA	P		
6	10				720004		TRANSISTOR 2N6718 UNSORTED	1	EA	P		
5	160				720007		TRANSISTOR MPSA14	4	EA	P		
5	170				720014		TRANSISTOR 2N6730 UNSORTED	2	EA	P		
5	180				720017		TRANSISTOR MPSA64	4	EA	P		
5	190				720036		TRANSISTOR LM394BH UNSORTED	1	EA	P		
5	200				720069A		TRANSISTOR MJE15030 SORTED A	1	EA	P		
6	10				720069		TRANSISTOR MJE15030 UNSORTED	1	EA	P		
5	210				720070A		TRANSISTOR MJE15031 SORTED A	2	EA	P		
6	10				720070		TRANSISTOR MJE15031 UNSORTED	1	EA	P		
5	220				720080		TRANSISTOR 2N5401	2	EA	P		
5	230				720084		TRANSISTOR 2N5551	2	EA	P		
5	240				720099A		TRANSISTOR MPS8099 SORTED A	2	EA	P		
6	10				720099		TRANSISTOR MPS8099 UNSORTED	1	EA	P		
5	250				720100A		TRANSISTOR MPS8599 SORTED A	2	EA	P		
6	10				720100		TRANSISTOR MPS8599 UNSORTED	1	EA	P		
5	260				400109		ELEC HDWRE PCPIN .040DX.082L GOLD	5	EA	P		
5	270				420094		WASHER #6 ITLW ZINC	3	EA	P		
5	280				420185		SCREW BINDER HD 6-32 X .250"	3	EA	P		
5	290				400007		ELEC HDWRE H/S TO-92 TYPE PCMT	2	EA	P		
5	300				400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	34	EA	P		
5	310				400055		ELEC HDWRE MOUNTING PAD 6 HOLE	1	EA	P		
5	320				400058		ELEC HDWRE MOUNTING PAD Y HOLE SPREAD	20	EA	P		
5	330				500475J		METAL NO27 TO220 H/S COCMP.	3	EA	P		
5	340		4/23/90		420046		NUT PEM 6-32 CUSTOM	12	EA	P		
5	350		4/23/90		500462J		METAL NO27 RAIL BAR COMP.	2	EA	P		
6	10				500462		METAL NO27 RAIL BAR RAW	1	EA	P		
5	360		8/25/90		430008		GASKET STRIP	2	IN	P		
5	370		4/ 1/92		LA2717		ML 27 ASSY AC-D3 PCBD LOWER LEVEL	1	EA	S		
6	10				100001		RES 10R0 RN60D 1% MET FLM 10R0F	6	EA	P		
6	20				100002		RES 20R0 RN60D 1% MET FLM 20R0F	8	EA	P		
6	30				100005		RES 45R3 RN60D 1% MET FLM 45R3F	2	EA	P		
6	40				100010		RES 100R RN60D 1% MET FLM 1000F	7	EA	P		
6	50				100016		RES 10K0 RN60D 1% MET FLM 1002F	2	EA	P		
6	60				100017		RES 10K0 RN65D 1% MET FLM 1002F	2	EA	P		
6	70				100021		RES 100K RN60C .1% MET FLM 1003B	3	EA	P		

Part Number MLC273 ML NO27 120 (Continued)
Revision Level: Engineering Status: AN Comment: 763206001000

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
6	80				100022		RES 100K RN65C .1% MET FLM 1003B	1	EA	P		
6	90				100030		RES 10R0 RN65D 1% MET FLM 10R0F	10	EA	P		
6	100				100107		RES 1R00 1W 1% TF-20 MET FILM 1R00F	2	EA	P		
6	110				100038		RES 115R RN60D 1% MET FLM 1150F	1	EA	P		
6	120				100055		RES 12K7 RN60D 1% MET FLM 1272F	1	EA	P		
6	130				100064		RES 1K40 RN60D 1% MET FLM 1401F	1	EA	P		
6	140				100071		RES 14K7 RN65C .1% MET FLM 1472B	1	EA	P		
6	150				100074		RES 150R RN60D 1% MET FLM 1500F	3	EA	P		
6	160				100080		RES 158R RN60D 1% MET FLM 1580F	1	EA	P		
6	170				100091		RES 16R2 RN60D 1% MET FILM RN60D16R2F	1	EA	P		
6	180				100110		RES 200R RN60D 1% MET FLM 2000F	2	EA	P		
6	190				100113		RES 2K00 RN60D 1% MET FLM 2001F	4	EA	P		
6	200				100116		RES 20K0 RN65D 1% MET FLM 2002F	2	EA	P		
6	210				100140		RES 2K43 RN60D 1% MET FLM 2431F	1	EA	P		
6	220				100149		RES 2K61 RN60D 1% MET FLM 2611F	2	EA	P		
6	230				100150		RES 2K74 RN60D 1% MET FLM 2741F	1	EA	P		
6	240				100152	1	RES 27K4 RN65D 1% MET FLM 2742F	1	EA	P		
6	250				100155		RES 287R RN60D 1% MET FLM 2870F	1	EA	P		
6	260				100157		RES 2K87 RN60D 1% MET FLM 2871F	2	EA	P		
6	270				100164		RES 3K01 RN60D 1% MET FLM 3011F	2	EA	P		
6	280				100168		RES 3K09 GS3 1% MET FLM	2	EA	P		
6	290				100200		RES 37K4 RN60D 1% MET FLM 3742F	1	EA	P		
6	300				100233		RES 4K64 RN60C .1% MET FLM 4641B	1	EA	P		
6	310				100234		RES 475R RN60D 1% MET FILM RN60D4750F	1	EA	P		
6	320				100246		RES 4K99 RN65D 1% MET FLM 4991F	2	EA	P		
6	330				100248		RES 4K99 RN60D 1% MET FLM 4991F	4	EA	P		
6	340				100273		RES 604R RN60C .1% MET FLM 6040B	3	EA	P		
6	350				100279		RES 60R4 RN60D 1% MET FLM 60R4F	8	EA	P		
6	360				100281		RES 6K34 RN65D 1% MET FLM 6341F	3	EA	P		
6	370				100293		RES 698R RN60D 1% MET FLM 6980F	1	EA	P		
6	380				100295		RES 6K98 RN60D 1% MET FLM 6981F	2	EA	P		
6	390				100314		RES 80R6 RN65D 1% MET FLM 80R6F	1	EA	P		
6	400				100337		RES 95K3 RN60C .1% MET FLM 9532B	1	EA	P		
6	410				110017		RES 10R0 5W 5% WW NONIND	1	EA	P		
6	420				110037		RES 0R22 5W 5% WW	12	EA	P		
6	430				220007		CAP 100P 100V PPRO 5% 100PF RAD	1	EA	P		
6	440				220009		CAP 220P 100V PPRO 5% 220PF RAD	3	EA	P		
6	450				220018		CAP 10N 63V PPRO 5% .01UF RADIAL	10	EA	P		
6	460				220019		CAP 10N 160V POLYPRO 5% .01UF AX	11	EA	P		
6	470				220021		CAP 1500PF 100V POLYPRO 2.5% FKP-2	2	EA	P		
6	480				220023		CAP 22N 100V PPRO 5% .022UF AX	3	EA	P		
6	490				700006		DIODE 1N4936 400V RECTIFIER	12	EA	P		
6	500				700038		DIODE 1N4003 1A 200V	3	EA	P		
6	510				700045		DIODE 1N4753	2	EA	P		
6	520				700051		DIODE 1N5371	1	EA	P		
6	530				230018		CAP 10P 200V CER NPO 10% 10PF CAP	1	EA	P		
6	540				230032		CAP 47P 200V CER NPO 10% 47PF RAD	1	EA	P		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
6	550				580200		PCBD NO.27 AC-3 AUDIO CHANNEL	1	EA	P		
6	560				400098		ELEC HDWRE PEM TERM .250L PHOS BRZ/TIN	3	EA	P		
6	570				420049J		STANDOFF SWAGE 6-32 X 1/4 X .375"L COMP	3	EA	P		
6	580				420051J		STANDOFF SWAGE 5/16DX10/32X3/16L RND COM	1	EA	P		
6	590				420052J		STANDOFF SWAGE 10-32 X 5/16 X .4375" COM	1	EA	P		
6	600				420053		STUD PEM 6/32X1/4L PCMT PHOS BRZ/TIN	4	EA	P		
6	610				400131		ELEC HDWRE PEMNUT 6/32PCMT CARBON/STEEL	3	EA	P		
6	620				400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	2	EA	P		
4	430			4/ 1/92	LA2717		ML 27 ASSY AC-D3 PCBD LOWER LEVEL	1	EA	S		
5	10				100001		RES 10R0 RN60D 1% MET FLM 10R0F	6	EA	P		
5	20				100002		RES 20R0 RN60D 1% MET FLM 20R0F	8	EA	P		
5	30				100005		RES 45R3 RN60D 1% MET FLM 45R3F	2	EA	P		
5	40				100010		RES 100R RN60D 1% MET FLM 1000F	7	EA	P		
5	50				100016		RES 10K0 RN60D 1% MET FLM 1002F	2	EA	P		
5	60				100017		RES 10K0 RN65D 1% MET FLM 1002F	2	EA	P		
5	70				100021		RES 100K RN60C .1% MET FLM 1003B	3	EA	P		
5	80				100022		RES 100K RN65C .1% MET FLM 1003B	1	EA	P		
5	90				100030		RES 10R0 RN65D 1% MET FLM 10R0F	10	EA	P		
5	100				100107		RES 1R00 1W 1% TF-20 MET FILM 1R00F	2	EA	P		
5	110				100038		RES 115R RN60D 1% MET FLM 1150F	1	EA	P		
5	120				100055		RES 12K7 RN60D 1% MET FLM 1272F	1	EA	P		
5	130				100064		RES 1K40 RN60D 1% MET FLM 1401F	1	EA	P		
5	140				100071		RES 14K7 RN65C .1% MET FLM 1472B	1	EA	P		
5	150				100074		RES 150R RN60D 1% MET FLM 1500F	3	EA	P		
5	160				100080		RES 158R RN60D 1% MET FLM 1580F	1	EA	P		
5	170				100091		RES 16R2 RN60D 1% MET FILM RN60D16R2F	1	EA	P		
5	180				100110		RES 200R RN60D 1% MET FLM 2000F	2	EA	P		
5	190				100113		RES 2K00 RN60D 1% MET FLM 2001F	4	EA	P		
5	200				100116		RES 20K0 RN65D 1% MET FLM 2002F	2	EA	P		
5	210				100140		RES 2K43 RN60D 1% MET FLM 2431F	1	EA	P		
5	220				100149		RES 2K61 RN60D 1% MET FLM 2611F	2	EA	P		
5	230				100150		RES 2K74 RN60D 1% MET FLM 2741F	1	EA	P		
5	240				100152	1	RES 27K4 RN65D 1% MET FLM 2742F	1	EA	P		
5	250				100155		RES 287R RN60D 1% MET FLM 2870F	1	EA	P		
5	260				100157		RES 2K87 RN60D 1% MET FLM 2871F	2	EA	P		
5	270				100164		RES 3K01 RN60D 1% MET FLM 3011F	2	EA	P		
5	280				100168		RES 3K09 GS3 1% MET FLM	2	EA	P		
5	290				100200		RES 37K4 RN60D 1% MET FLM 3742F	1	EA	P		
5	300				100233		RES 4K64 RN60C .1% MET FLM 4641B	1	EA	P		
5	310				100234		RES 475R RN60D 1% MET FILM RN60D4750F	1	EA	P		
5	320				100246		RES 4K99 RN65D 1% MET FLM 4991F	2	EA	P		
5	330				100248		RES 4K99 RN60D 1% MET FLM 4991F	4	EA	P		
5	340				100273		RES 604R RN60C .1% MET FLM 6040B	3	EA	P		
5	350				100279		RES 60R4 RN60D 1% MET FLM 60R4F	8	EA	P		
5	360				100281		RES 6K34 RN65D 1% MET FLM 6341F	3	EA	P		
5	370				100293		RES 698R RN60D 1% MET FLM 6980F	1	EA	P		
5	380				100295		RES 6K98 RN60D 1% MET FLM 6981F	2	EA	P		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	S C	B i n	P h a n t o m
5	390				100314		RES 80R6 RN65D 1% MET FLM 80R6F	1	EA	P		
5	400				100337		RES 95K3 RN60C .1% MET FLM 9532B	1	EA	P		
5	410				110017		RES 10R0 5W 5% WW NONIND	1	EA	P		
5	420				110037		RES 0R22 5W 5% WW	12	EA	P		
5	430				220007		CAP 100P 100V PPRO 5% 100PF RAD	1	EA	P		
5	440				220009		CAP 220P 100V PPRO 5% 220PF RAD	3	EA	P		
5	450				220018		CAP 10N 63V PPRO 5% .01UF RADIAL	10	EA	P		
5	460				220019		CAP 10N 160V POLYPRO 5% .01UF AX	11	EA	P		
5	470				220021		CAP 1500PF 100V POLYPRO 2.5% FKP-2	2	EA	P		
5	480				220023		CAP 22N 100V PPRO 5% .022UF AX	3	EA	P		
5	490				700006		DIODE 1N4936 400V RECTIFIER	12	EA	P		
5	500				700038		DIODE 1N4003 1A 200V	3	EA	P		
5	510				700045		DIODE 1N4753	2	EA	P		
5	520				700051		DIODE 1N5371	1	EA	P		
5	530				230018		CAP 10P 200V CER NPO 10% 10PF CAP	1	EA	P		
5	540				230032		CAP 47P 200V CER NPO 10% 47PF RAD	1	EA	P		
5	550				580200		PCBD NO.27 AC-3 AUDIO CHANNEL	1	EA	P		
5	560				400098		ELEC HDWRE PEM TERM .250L PHOS BRZ/TIN	3	EA	P		
5	570				420049J		STANDOFF SWAGE 6-32 X 1/4 X .375"L COMP	3	EA	P		
5	580				420051J		STANDOFF SWAGE 5/16DX10/32X3/16L RND COM	1	EA	P		
5	590				420052J		STANDOFF SWAGE 10-32 X 5/16 X .4375" COM	1	EA	P		
5	600				420053		STUD PEM 6/32X1/4L PCMT PHOS BRZ/TIN	4	EA	P		
5	610				400131		ELEC HDWRE PEMNUT 6/32PCMT CARBON/STEEL	3	EA	P		
5	620				400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	2	EA	P		
4	440				LA2716		ML 27 ASSY PCBD AT2	1	EA	S		
5	10				100016		RES 10K0 RN60D 1% MET FLM 1002F	2	EA	P		
5	20				100017		RES 10K0 RN65D 1% MET FLM 1002F	1	EA	P		
5	30				100015		RES 10K0 RN65C .1% MET FLM 1002B	2	EA	P		
5	40				100078		RES 15K0 RN60D 1% MET FLM 1502F	1	EA	P		
5	50				100119		RES 2M00 RN60D 1% MET FLM 2004F	1	EA	P		
5	60				100137	1	RES 2K40 GS3 1% MET FLM	1	EA	P		
5	70				100258		RES 51K1 RN60D 1% MET FLM 5112F	3	EA	P		
5	80			6/ 1/91	220014		THIS PART NO LONGER EXISTS	2	EA	P		
5	85		6/ 1/91		220015		CAP 1N 100V PPRO 2.5% 1000PF RAD	2	EA	P		
5	90				200019		CAP 10U 35V LYTIC RAD PCMT	1	EA	P		
5	100				700006		DIODE 1N4936 400V RECTIFIER	3	EA	P		
5	110				700022		DIODE 1N914B	1	EA	P		
5	120				700023		DIODE 1N963B 500MW 12V 5% ZENER	1	EA	P		
5	130				700024		DIODE 1N977B 500MW 47V ZENER	1	EA	P		
5	140				700044		DIODE 1N4742	1	EA	P		
5	150				720004		TRANSISTOR 2N6718 UNSORTED	2	EA	P		
5	160				720014		TRANSISTOR 2N6730 UNSORTED	1	EA	P		
5	170				720016		TRANSISTOR VN0109N3 N-CHANNEL MOSFET	1	EA	P		
5	180				720060		TRANSISTOR 2N4392 UNSORTED	1	EA	P		
5	190				580180		PCB NO.27 AT-2 "A"	1	EA	P		
5	200				400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	4	EA	P		
5	210				400058		ELEC HDWRE MOUNTING PAD Y HOLE SPREAD	5	EA	P		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	S C	B i n	P ht ao nm
5	220		9/ 1/90		400058		ELEC HDWRE MOUNTING PAD Y HOLE SPREAD	1	EA	P		
3	170				LA2715		ML 27 A&T CH W/PWR SUPPLY	1	EA	S		
4	10				200047		CAP 1900UF 150V LYTIC SCREW MT	4	EA	P		
4	20				200058		CAP 45M 75V LYTIC SCREW MT 45000UF	4	EA	P		
4	30				290006		XFMR 729VA NO.27	2	EA	P		
4	40				420084		SCREW SLOTTED 10-32 X .375 BRASS	16	EA	P		
4	50				420128		SCREW BINDER HD 10-32 X .625"	4	EA	P		
4	60				420141		WASHER LOCKING SPLIT RING	2	EA	P		
4	70				420251		WASHER FLAT #6 SMALL PATTERN	4	EA	P		
4	80				420197		BOLT HEX HD.XFMR 3/8X 4"L	2	EA	P		
4	90				460017		HDWRE PLSTC NYLON TYWRAP 4"	3	EA	P		
4	100				500464J		METAL NO27 GROUND BAR COMP.	2	EA	P		
4	110				500473J		METAL NO27 CAP CLAMP COMP	4	EA	P		
5	10				500473		METAL NO27 CAP CLAMP RAW	1	EA	P		
4	120				LB2700		ML 27 ASSY CH MECHANICAL	1	EA	S		
5	10				700037		DIODE KBPC3504P BRIDGE RECT	2	EA	P		
5	20				700060		DIODE BRIDGE RECTIFIER IR 35MB40A	2	EA	P		
5	30				420089		WASHER #10 ITLW	4	EA	P		
5	40				420090		NUT HEX 6-32X.25	12	EA	P		
5	50				420093		NUT HEX 4-40X.25	4	EA	P		
5	60				420094		WASHER #6 ITLW ZINC	16	EA	P		
5	70				420095		WASHER #4 ITLW SS	9	EA	P		
5	80				420256		SCREW SHSC 10-32X.625	4	EA	P		
5	90				420104		SCREW BINDER HD 6-32 X .875" SS	2	EA	P		
5	100				420107		WASHER #6 FLAT	14	EA	P		
5	110				420116		WASHER #10 ITLW	72	EA	P		
5	120				420127		NUT HEX 10-32X.375	12	EA	P		
5	130				420162		SCREW PH. FH. 8-32X 3/8 100DEGREE	4	EA	P		
5	140				420168		SCREW FHSCS 4-40X.25 S.S.	4	EA	P		
5	150				420170		SCREW BHCS 4-40 X .500	2	EA	P		
5	160				420187		SCREW BHMS 4-40X .25	5	EA	P		
5	170				420198		SCREW BHSCS 4-40 X .25 SS	4	EA	P		
5	180				420205		SCREW BHSCS 8/32X.25	4	EA	P		
5	190				420252		STANDOFF 6-32 X 1/4 X 1.50"L	4	EA	P		
5	200				460080		HDWRE PLSTIC DELRIN SLEEVE ML-7	2	EA	P		
5	210				350068		SWITCH CB NO.20/20.5/23/27	1	EA	P		
5	220				350070		FUSE FUSE HOLDER 342858L	2	EA	P		
5	230				350095		RELAY POWER 30AMP	1	EA	P		
5	240				330067		CONN CHMT BP 10-32 RED GOLD PL	2	EA	P		
5	250				330069		CONN CHMT BP 10-32BLACK GOLD PL	2	EA	P		
5	260				330077		CONN CHMT AC	1	EA	P		
5	270			5/30/91	330086		CONN CHMT XLR 3PIN FEM GOLD PL	2	EA	P		
5	275		5/30/91		330092		CONN CHMT XLR 3PIN FEM/MOD GOLD PL	2	EA	P		
5	280				500458J		METAL ML9 FRONT HANDLE COMP.	2	EA	P		
6	10				500458C		METAL ML9 FRONT HANDLE BUFFED	1	EA	P		
7	10				500458		METAL ML9 FRONT HANDLE RAW	1	EA	P		
5	290				500461J		METAL NO27 REAR PANEL COMP	1	EA	P		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
6	10				500461		METAL NO27 REAR PANEL RAW	1	EA	P		
5	300			12/28/92	500463J		METAL NO27 XFMR TUNNEL COMP.	1	EA	P		
5	305		12/28/92		500463J-1		METAL NO27/27.5 XFMR TUNNEL COMPL.	1	EA	P		
5	310				500474J		METAL NO27 FALSE FRONT COMP.	1	EA	P		
5	320				LA2700		ML 27 ASSY PCBD VB5	1	EA	S		
6	10				100013		RES 1K00 RN60D 1% MET FLM 1001F	1	EA	P		
6	20				100010		RES 100R RN60D 1% MET FLM 1000F	1	EA	P		
6	30				100016		RES 10K0 RN60D 1% MET FLM 1002F	2	EA	P		
6	40				100297		RES 715R RN60D 1% MET FLM 7150F	1	EA	P		
6	50				110018		RES 10R0 10W 5% WW	3	EA	P		
6	60				110019		RES 10R0 5W 5% WW PW5	2	EA	P		
6	70				110026		RES 2R2 2W 10% WW	2	EA	P		
6	80				110025		RES 200R 5W 5% WW PW5	1	EA	P		
6	90				110033		RES 68R0 2W 10% WW	5	EA	P		
6	100				110046		RES 33R0 5W 5% WW PW5	1	EA	P		
6	110				110042		RES 2K4 5W 10% WW	1	EA	P		
6	120				220034		CAP 47N 600V POLYESTER 10% .047UF RAD	1	EA	P		
6	130				220035		CAP 470N 160V MET POLYESTER 10% .47UF RA	2	EA	P		
6	140				220038		CAP 100N 250V MET PPRO 10% .1UF RAD	9	EA	P		
6	150				110057		RES 22K0 4W 5% WW	1	EA	P		
6	160				220045		CAP 4N7 5KV MET PAPER 20% 4700P RAD	9	EA	P		
6	170				230015		CAP 100N 100V CER 10% Z5U RADIAL	5	EA	P		
6	180				200020		CAP 10000U 6.3V AXIAL LYTIC PCMT	4	EA	P		
6	190				200022		CAP 100U 50V LYTIC AX PCMT	1	EA	P		
6	200				200036		CAP 6.8U 50V LYTIC RADIAL PCMT	1	EA	P		
6	210				700006		DIODE 1N4936 400V RECTIFIER	13	EA	P		
6	220				700021		DIODE MR 752	4	EA	P		
6	230				700029		DIODE S2800D SCR	1	EA	P		
6	240				700035		DIODE P300J	4	EA	P		
6	250				700038		DIODE 1N4003 1A 200V	6	EA	P		
6	260				700044		DIODE 1N4742	1	EA	P		
6	270				700047		DIODE 1N5252B	1	EA	P		
6	280				720023		TRANSISTOR 4N33 OPTOCOUPLER	2	EA	P		
6	290				720027		TRANSISTOR TIP125	1	EA	P		
6	300				720080		TRANSISTOR 2N5401	1	EA	P		
6	310				580206		PCBD NO.27 VB-5 PCBD	1	EA	P		
6	320				400114		ELEC HDWRE TAB PCMT	66	EA	P		
6	330				420124		WASHER #4 ITLW BRONZE	2	EA	P		
6	340				420125		NUT HEX 4-40 BRASS	2	EA	P		
6	350				420129		SCREW SLOTTED 4-40 X .250 BRASS	2	EA	P		
6	360				460075		HDWRE PLSTIC INSULATOR TO-220	2	EA	P		
6	370				350062		FUSE 15 AMP	2	EA	P		
6	380			5/ 1/92	400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	7	EA	P		
6	385		5/ 1/92		400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	5	EA	P		
6	390				400058		ELEC HDWRE MOUNTING PAD Y HOLE SPREAD	1	EA	P		
6	400				400048		ELEC HDWRE H/S TO-220 PCMT EDGE FINISH	1	EA	P		
6	410				400062		ELEC HDWRE INSULATOR TO-220 MICA	1	EA	P		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	S C	B i n	P h a n t o m
6	420				400102		CLIP FUSE PCMT	4	EA	P		
6	430				430008		GASKET STRIP	6	IN	P		
5	330				LA2701		ML 27 A&T PCBD OL3L	1	EA	S		
6	10				100002		RES 20R0 RN60D 1% MET FLM 20R0F	4	EA	P		
6	20				100005		RES 45R3 RN60D 1% MET FLM 45R3F	4	EA	P		
6	30				100013		RES 1K00 RN60D 1% MET FLM 1001F	5	EA	P		
6	40				100009		RES 100R RN60C .1% MET FLM 1000B	2	EA	P		
6	50				100010		RES 100R RN60D 1% MET FLM 1000F	2	EA	P		
6	60				100016		RES 10K0 RN60D 1% MET FLM 1002F	5	EA	P		
6	70				100017		RES 10K0 RN65D 1% MET FLM 1002F	1	EA	P		
6	80				100087	1	RES 16K2 RN65D 1% MET FLM 1622F	1	EA	P		
6	90				100116		RES 20K0 RN65D 1% MET FLM 2002F	1	EA	P		
6	100				100225		RES 4K32 RN60D 1% MET FLM 4321F	2	EA	P		
6	110				100317		RES 82R5 RN60D 1% MET FLM 82R5F	2	EA	P		
6	120				120017		RES 27K0 1W 5% CC	1	EA	P		
6	130				220007		CAP 100P 100V PPRO 5% 100PF RAD	4	EA	P		
6	140				220018		CAP 10N 63V PPRO 5% .01UF RADIAL	4	EA	P		
6	150				220035		CAP 470N 160V MET POLYESTER 10% .47UF RA	1	EA	P		
6	160				230014		CAP 470N 100V CER 10% X7R RAD	1	EA	P		
6	170				230015		CAP 100N 100V CER 10% Z5U RADIAL	1	EA	P		
6	180				200059		CAP 470U 10V LYTIC RAD PCMT	3	EA	P		
6	190				700006		DIODE 1N4936 400V RECTIFIER	14	EA	P		
6	200				700038		DIODE 1N4003 1A 200V	7	EA	P		
6	210				280005		INDUCTOR, FERRITE BEAD	4	EA	P		
6	220				720004		TRANSISTOR 2N6718 UNSORTED	1	EA	P		
6	230				720014		TRANSISTOR 2N6730 UNSORTED	1	EA	P		
6	240				720080		TRANSISTOR 2N5401	2	EA	P		
6	250				720084		TRANSISTOR 2N5551	2	EA	P		
6	260				580181		PCB NO.27 OL-3 L+R "A"	1	EA	P		
6	270				400098		ELEC HDWRE PEM TERM .250L PHOS BRZ/TIN	8	EA	P		
6	280				420116		WASHER #10 ITLW	4	EA	P		
6	290			11/22/91	420124		WASHER #4 ITLW BRONZE	2	EA	P		
6	295		11/22/91		420124		WASHER #4 ITLW BRONZE	4	EA	P		
6	300				420127		NUT HEX 10-32X.375	2	EA	P		
6	310				420128		SCREW BINDER HD 10-32 X .625"	2	EA	P		
6	320				420129		SCREW SLOTTED 4-40 X .250 BRASS	2	EA	P		
6	330				420213		STANDOFF .437L	2	EA	P		
6	340				330023		CONN PCMT CAMAC COAX GOLD PL	1	EA	P		
6	350				330174		CONN PCMT 7PIN HEADER .156" LOCKING	1	EA	P		
6	360				400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	2	EA	P		
6	370				400053		ELEC HDWRE INSULATOR SQUARE 5 HOLE FILM	1	EA	P		
6	380				400058		ELEC HDWRE MOUNTING PAD Y HOLE SPREAD	6	EA	P		
5	340				LA2702		ML 27 A&T PCBD OL3R	1	EA	S		
6	10				100002		RES 20R0 RN60D 1% MET FLM 20R0F	4	EA	P		
6	20				100005		RES 45R3 RN60D 1% MET FLM 45R3F	4	EA	P		
6	30				100013		RES 1K00 RN60D 1% MET FLM 1001F	5	EA	P		
6	40				100009		RES 100R RN60C .1% MET FLM 1000B	2	EA	P		

Part Number MLC273 ML NO27 120 (Continued)
Revision Level: Engineering Status: AN Comment: 763206001000

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
6	50				100010		RES 100R RN60D 1% MET FLM 1000F	2	EA	P		
6	60				100016		RES 10K0 RN60D 1% MET FLM 1002F	5	EA	P		
6	70				100017		RES 10K0 RN65D 1% MET FLM 1002F	1	EA	P		
6	80				100087	1	RES 16K2 RN65D 1% MET FLM 1622F	1	EA	P		
6	90				100116		RES 20K0 RN65D 1% MET FLM 2002F	1	EA	P		
6	100				100225		RES 4K32 RN60D 1% MET FLM 4321F	2	EA	P		
6	110				100317		RES 82R5 RN60D 1% MET FLM 82R5F	2	EA	P		
6	120				120017		RES 27K0 1W 5% CC	1	EA	P		
6	130				220007		CAP 100P 100V PPRO 5% 100PF RAD	4	EA	P		
6	140				220018		CAP 10N 63V PPRO 5% .01UF RADIAL	4	EA	P		
6	150				220035		CAP 470N 160V MET POLYESTER 10% .47UF RA	1	EA	P		
6	160				230014		CAP 470N 100V CER 10% X7R RAD	1	EA	P		
6	170				230015		CAP 100N 100V CER 10% Z5U RADIAL	1	EA	P		
6	180				200059		CAP 470U 10V LYTIC RAD PCMT	3	EA	P		
6	190				700006		DIODE 1N4936 400V RECTIFIER	14	EA	P		
6	200				700038		DIODE 1N4003 1A 200V	7	EA	P		
6	210				280005		INDUCTOR, FERRITE BEAD	4	EA	P		
6	220				720004		TRANSISTOR 2N6718 UNSORTED	1	EA	P		
6	230				720014		TRANSISTOR 2N6730 UNSORTED	1	EA	P		
6	240				720080		TRANSISTOR 2N5401	2	EA	P		
6	250				720084		TRANSISTOR 2N5551	2	EA	P		
6	260				580181		PCB NO.27 OL-3 L+R "A"	1	EA	P		
6	270				400098		ELEC HDWRE PEM TERM .250L PHOS BRZ/TIN	8	EA	P		
6	280				420116		WASHER #10 ITLW	4	EA	P		
6	290			11/22/91	420124		WASHER #4 ITLW BRONZE	2	EA	P		
6	295		11/22/91		420124		WASHER #4 ITLW BRONZE	4	EA	P		
6	300				420127		NUT HEX 10-32X.375	2	EA	P		
6	310				420128		SCREW BINDER HD 10-32 X .625"	2	EA	P		
6	320				420129		SCREW SLOTTED 4-40 X .250 BRASS	2	EA	P		
6	330				420213		STANDOFF .437L	2	EA	P		
6	340				330023		CONN PCMT CAMAC COAX GOLD PL	1	EA	P		
6	350				330174		CONN PCMT 7PIN HEADER .156" LOCKING	1	EA	P		
6	360				400030		ELEC HDWRE MOUNTING PAD 2HOLE OBROUND	2	EA	P		
6	370				400053		ELEC HDWRE INSULATOR SQUARE 5 HOLE FILM	1	EA	P		
6	380				400058		ELEC HDWRE MOUNTING PAD Y HOLE SPREAD	6	EA	P		
4	130				LB2701		ML 27 ASSY WIRE PREP	1	EA	S		
5	10				310026		CABLE 7COND.UNSHIELDED TWIN LEAD BEIGE	23.5000	IN	P		
5	20				300012		WIRE HOOK-UP 2.5MM2 ISOLA RED	20	IN	P		
5	30				300018		WIRE HOOK-UP 2.5MM2 ISOLA BLACK	20	IN	P		
5	40				300026		WIRE HOOK-UP 2.5MM2 ISOLA BLUE	17	IN	P		
5	50				300030		WIRE HOOK-UP SILVER RF CHAS. BLUE	35.2500	IN	P		
5	60				300031		WIRE HOOK-UP SILVER RF CHAS. WHITE	35	IN	P		
5	70				300032		WIRE HOOK-UP SILVER 32AWG BLACK	35.2500	IN	P		
5	80				300039		WIRE HOOK-UP 14AWG STRANDED PVC RED	42	IN	P		
5	90				300040		WIRE HOOK-UP 14AWG STRANDED PVC GREEN	15.2500	IN	P		
5	100				300041		WIRE HOOK-UP 14AWG STRANDED PVC WHITE	21.2500	IN	P		
5	110				300042		WIRE HOOK-UP 14AWG STRANDED PVC BLACK	44.2500	IN	P		

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	P ht ao m
5	120				300043		WIRE HOOK-UP 14AWG STRANDED PVC YELLOW	20.5000	IN	P		
5	130				300044		WIRE HOOK-UP 14AWG STRANDED PVC BLUE	24.2500	IN	P		
5	140				300045		WIRE HOOK-UP 14AWG STRANDED PVC BROWN	11.5000	IN	P		
5	150				300046		WIRE HOOK-UP 14AWG STRANDED PVC GRAY	19.2500	IN	P		
5	160				300047		WIRE HOOK-UP 14AWG STRANDED PVC ORANGE	11.7500	INCH	P		
5	170				300053		WIRE HOOK-UP 22AWG RED	11.5000	IN	P		
5	180				300055		WIRE HOOK-UP 22AWG YELLOW	11.5000	IN	P		
5	190				300056		WIRE HOOK-UP 22AWG GREEN	10	IN	P		
5	200				300061		WIRE HOOK-UP 22AWG BLACK TEFLON	12	IN	P		
5	210				300075		WIRE BRAID SN PL CU	22	IN	P		
5	220				440009		TUBING SHRK .375 RED 1"L	4	EA	P		
5	230				440010		TUBING SHRK .375 BLACK UNCUT	23	IN	P		
5	240				440016		TUBING SHRK .125 BLACK .5L	16	EA	P		
5	250				440024		TUBING SHRK .187 BLACK 1"L	3	EA	P		
5	260				440030		TUBING SHRK .375 BLACK 1"L	12	EA	P		
5	270				400073		ELEC HDWR FASTON .250 RED FEMALE 18-22	8	EA	P		
5	280				400075		ELEC HDWRE FASTON .187 PINK FEMALE	2	EA	P		
5	290				400078		ELEC HDWRE LUG RING TERM CRIMP TYPE	12	EA	P		
5	300			5/ 1/91	400083		ELEC HDWRE TERMINAL RING TONGUE TYPE	15	EA	P		
5	305		5/ 1/91		400201		ELEC HDWRE RING TERMINAL #10 BLUE/MOLEX	15	EA	P		
5	310				400089		ELEC HDWRE FASTON .250 BLUE FEM 14-16AWG	62	EA	P		
5	320			5/ 1/91	400096		ELEC HDWRE TERMINAL PIDG #10 INSUL STUD	6	EA	P		
5	325		5/ 1/91		400202		ELEC HDWRE RING TERMINAL #10 YELLOW	6	EA	P		
5	330			5/ 1/91	400099		ELEC HDWRE TERMINAL PIDG #6 10-12AWG	6	EA	P		
5	335		5/ 1/91		400200		ELEC HDWRE RING TERM #6 YELLOW 10-12AWG	6	EA	P		
5	340				400119		ELEC HDWRE FASTON 90 DEG 14-16AWG BLUE	16	EA	P		
4	140				420600		WASHER FLAT 3/8"X.370 ID-X .070THK ZP	2	EA	P		
2	170		10/31/91		LA2799		ML SHIP KIT NO27	1	EA	S		
3	10				460019		HDWRE PLSTC NYLON TYWRAP 7.75"L	1	EA	P		
3	20				480095		LABEL ACCESSORY FOR ALL UNITS	1	EA	P		
3	30				310011		CORDSET 3COND SH AC 14AWG BLACK	1	EA	P		
3	40				630068		MANUAL MLTEC NO.27 OWNER'S	1	EA	P		
3	50			5/ 6/91	630047		MANUAL MACOVER BLACK	1	EA	P		
3	51		5/ 6/91		600208		PACKING NO27 MANUAL COVER	1	EA	P		
3	60				600009		PACKING PLASTIC BAG FOR ML2	1	EA	P		
3	70				600011		PACKING PLASTIC BAG FOR MANUALS 10 X 12	1	EA	P		
3	80			7/ 9/91	600025		PACKING NO.23 PACKING SPREADER	2	EA	P		
3	81		7/ 9/91		600175		PACKING NO23.5/NO27 SPREADER	1	EA	P		
3	90				600026		PACKING NO.23 INNER CARTON	1	EA	P		
3	100				600027		PACKING NO.23 FOAM END CAP	2	EA	P		
3	110				600028		PACKING NO.23 OUTER CARTON	1	EA	P		
3	120				600029		PACKING NO.23 OUTER CARTON WRAP	1	EA	P		
3	130				600030		PACKIN NO.23 INNER BOX FOAM	2	EA	P		
3	140				600034		PACKING NO.27 INNER BOX FOAM	1	EA	P		
3	145		3/ 9/92		600219		PACKING DESSICANT PACK	1	EA	P		
3	150				630064		MANUAL MAWARRANTY CARD FOR ALL UNITS	1	EA	P		
3	160				630065		MANUAL MLENV WARRANTY ENVELOPES	1	EA	P		

Part Number MLC273 ML NO27 120 (Continued)
Revision Level: Engineering Status: AN Comment: 763206001000

Level	Line	Rev	Start Date	Stop Date	Part Number	Rev	Description	Quantity	U/M	SC	Bin	Phantom
1	20			10/31/91	LA2799		ML SHIP KIT NO27	1	EA	S		
2	10				460019		HDWRE PLSTC NYLON TYWRAP 7.75"L	1	EA	P		
2	20				480095		LABEL ACCESSORY FOR ALL UNITS	1	EA	P		
2	30				310011		CORDSET 3COND SH AC 14AWG BLACK	1	EA	P		
2	40				630068		MANUAL MLTEC NO.27 OWNER'S	1	EA	P		
2	50			5/ 6/91	630047		MANUAL MACOVER BLACK	1	EA	P		
2	51		5/ 6/91		600208		PACKING NO27 MANUAL COVER	1	EA	P		
2	60				600009		PACKING PLASTIC BAG FOR ML2	1	EA	P		
2	70				600011		PACKING PLASTIC BAG FOR MANUALS 10 X 12	1	EA	P		
2	80			7/ 9/91	600025		PACKING NO.23 PACKING SPREADER	2	EA	P		
2	81		7/ 9/91		600175		PACKING NO23.5/NO27 SPREADER	1	EA	P		
2	90				600026		PACKING NO.23 INNER CARTON	1	EA	P		
2	100				600027		PACKING NO.23 FOAM END CAP	2	EA	P		
2	110				600028		PACKING NO.23 OUTER CARTON	1	EA	P		
2	120				600029		PACKING NO.23 OUTER CARTON WRAP	1	EA	P		
2	130				600030		PACKIN NO.23 INNER BOX FOAM	2	EA	P		
2	140				600034		PACKING NO.27 INNER BOX FOAM	1	EA	P		
2	145		3/ 9/92		600219		PACKING DESSICANT PACK	1	EA	P		
2	150				630064		MANUAL MAWARRANTY CARD FOR ALL UNITS	1	EA	P		
2	160				630065		MANUAL MLENV WARRANTY ENVELOPES	1	EA	P		

NO.27 DUAL MONAURAL POWER AMPLIFIER SERVICE INSTRUCTIONS

Madrigal Audio Laboratories, Inc.
2081 South Main Street
Middletown, Connecticut 06457
U. S. A.
Telephone (203) 346-0896
Fax (203) 346-1540
ITT Telex 4942158
P/N 87004900SRVC

SERVICE TO BE PERFORMED	FOLLOW STEPS	SEE DRAWINGS
REPLACE TOP COVER	1.0, 12.1	
REPLACE BOTTOM COVER	1.1, 12.0	
REPLACE HEATSINK COVER	2.0	
REPLACE REAR PANEL ITEM (BINDING POST, AC CONNECTOR, FUSEHOLDER, OL-3 PC ASSY., 3-PIN CONNECTOR)	1.0, 1.1, 4.0 - 4.4, 5.0, 5.1, 11.6, 11.7, 11.8, 12.0, 12.1	A, C, G
REPLACE AUDIO CHANNEL	1.0, 1.1, 3.0 - 3.6, 11.0 - 11.5, 11.7, 11.9, 12.0, 12.1	D, E, F, G
REPLACE OUTPUT DEVICE	1.0, 1.1, 2.0, 3.0 - 3.6, 5.0, 5.1, 7.0 - 7.2, 6.0, 11.0, 11.2 -11.5, 11.7, 11.9, 12.0, 12.1	B, D, E, F, G
REPLACE AUDIO CHANNEL COMPONENT	1.0, 1.1, 3.0 - 3.6, 5.0, 5.1, 6.0, 7.0 - 7.2, 11.0, 11.2 - 11.5, 11.7, 11.9, 12.0, 12.1	D, E, F, G
REPLACE VB-5	1.1, 8.0 - 8.2, 12.0	
REPLACE TRANSFORMER	1.0, 1.1, 9.0, 12.0, 12.1	
REPLACE FRONT PLATE	1.0, 1.1, 10.0 - 10.7, 11.4, 11.5, 12.0, 12.1	G
REPLACE FRONT HANDLE	1.0, 1.1, 10.0, 10.1, 10.3 - 10.5, 11.4, 11.5, 12.0, 12.1	G

Always disconnect AC mains before working on any part of the No. 27 amplifier.

It is *essential* that all eight power supply capacitors be *fully discharged* once bottom cover has been removed and before any further work is attempted. Heavy-duty, insulated alligator clips should be soldered to both ends of a two- to five-ohm, five watt or larger resistor. One clip should be connected to each channel's rectangular ground bar while the other is clipped firmly to the supply terminal of each of four electrolytic filter capacitors for at least five seconds. This should be repeated for the other channel. *Failure to observe this precaution can result in shock, injury or damage to the amplifier.*

Amplifier should be placed on a clean surface for disassembly. Foam or soft cloth should be taped around front and rear handles to prevent scarring since the chassis will be tipped onto handles during disassembly.

1.0 Using 5/64" Allen driver (Xcelite LN22 or equivalent), remove twelve buttonhead screws securing top cover to amplifier.

1.1 Using 5/64" Allen driver, remove twelve buttonhead screws securing bottom cover to amplifier.

2.0 Using large blade (5/16" recommended) screwdriver, remove thumbscrews securing heatsink cover. Do not touch cases of TO-3 output transistors with heatsink covers, screwdriver, or any other conductive object until power supply capacitors have been fully discharged (see above).

3.0 When removing heatsunk channel, it is most convenient to rest the amplifier on its side so that channel being removed is facing upward.

3.1 Using large blade screwdriver, remove two 10-32 brass screws securing channel rail bars to supply filter capacitors. Carefully remove all lockwashers from screw and retain.

3.2 Using 9/64" Allen driver (Xcelite LN964 or equivalent), remove four 8-32 machine screws securing channel to false front and rear panels.

3.3 Channel is now loose. Gently separate it from chassis, unhooking red, black, and blue HF-2.5 wires from chassis-mounted filter capacitors.

3.4 Desolder shielded input cable from OL-3 wire terminals.

3.5 Pull top of audio channel away from chassis. Using medium blade (3/16" recommended) screwdriver, unscrew three 6-32 brass screws that secure black, red and blue HF-2.5 wires to channel. Remove and retain along with lockwashers. Using large blade screwdriver, unscrew 10-32 brass screws and disconnect output cables from channel. Remove and retain along with lockwashers.

3.6 Using medium blade screwdriver, remove seven-pin connector from OL-3 and carefully separate audio channel from chassis and set aside.

4.0 Using 9/64" Allen driver, remove two 8-32 machine screws securing each channel to rear panel. Desolder shielded input cables from OL-3 wire terminals. Tilt the amplifier onto its front handles.

4.1 Using 3/32" Allen driver (Xcelite LN23 or equivalent), remove four buttonhead screws securing rear panel to amplifier chassis.

4.2 Refer to drawing A. Pull the rear panel away from the amplifier in the manner shown. Disconnect seven-pin connector with medium blade screwdriver.

4.3 Refer to M.A.L. Rear Panel drawing #75-3205-00-00-00 for part numbers and locations. A 3/8" hex driver should be used with all 10-32 hex nuts, and a 11/16" wrench or sparkplug socket on fuseholder hex nuts. Be sure to observe a maximum torque of 11 inch-pounds on fuseholders and 20 inch-pounds on binding posts.

4.4 When removing and replacing wired items, pay special attention to routing of wires for best electrical performance. See drawing C.

5.0 Refer to M.A.L. drawing #75-3200-00-00-00S (VB-5 and Power Supply Wiring), 75-3201/3202-00-00-00S (OL-3), 75-3203-00-00-00S (AC-3) and 75-3208-00-00-00S (AT-2) for complete schematics.

5.1 Refer to M. A. L. drawing #75-3200-00-00-00AC (VB-5), #75-3201- and 3202-00-00-00AC (OL-3 L and R), #75-3203-00-00-00AC (AC-3), and #75-3208-00-00-00AC (AT-2) for proper location of parts and hardware. Use good workmanship practices in removing and replacing parts. Replacement of some components on AC-3 will require removal of heatsink(s) to gain access to solder side of PC board. See Section 7 for removal of heatsink. If component side replacement is feasible, the defective part should be cut from the assembly leaving as long a lead as possible remaining on the board. By grasping lead with pliers and heating the solder joint, holes can be cleared for new part. Precut leads of replacement part so that no leads extend more that .025" from solder side of board. Replacement parts can be soldered in place from topside. In some cases, use of mounting pads may be impossible. Avoid excessive heat in removal and soldering; clean all soldered connections with freon; inspect for pinholes, solder bridges and burned components.

6.0 When repairs are completed, amplifier should be allowed to idle for one half hour before the following DC checks are made:

Regulated DC voltages: + and - 65.200 to 65.300 VDC, tracking within 50 mV.

Regulator output current: 140-150 mA, or 1.4 to1.5 VDC across R114 and R115.

DCO: less than 30 mV.

Output stage bias: 40 mA per device, or 17.6 mV across R122 and R123.

7.0 To remove heatsunk device, first unscrew defective device fully from heatsink. Two leads must be desoldered from PC board before TO-3 devices are free. TO-220 devices are best removed by clipping leads from body and individually desoldering them from PC board.

7.1 Never reuse solder cup lead extenders or mica insulators. Inspect all heatsink and device mating surfaces for debris. Refer to M.A.L. drawing # 75-3204-00-00-00 when replacing parts, paying particular attention that the proper hardware is used to secure a part.

7.2 Apply fresh thermal compound to mica insulators and position carefully on heatsink. Check that all device leads are parallel, bent and clipped correctly (see Drawing B) and that shoulder washers fully isolate mounting hardware from device cases. Tighten all hardware to specified torque before soldering any leads. In general, all 6-32 hardware should be tightened to 12 inch-pounds and all 4-40 hardware to 3 inch-pounds.

8.0 Remove all Faston terminated wires from VB-5 PC connections. Refer to M.A.L drawing #75-3205-00-00-00. Remove five 4-40 X 1/4"L screws and ITLWs securing assembly to transformer tunnel.

8.1 Remove one bridge rectifier from tunnel side. Lift defective VB-5 from tunnel and replace with new assembly. Be sure to orient new assembly so that large blue electrolytic capacitors are toward the rear of the amplifier. Secure with five 4-40 screws and #4 ITLWs. Reinstall bridge rectifier.

8.2 Refer to M.A.L. drawing #75-3207-00-00-00 and reconnect all wires to VB-5.

9.0 Note that T1, left channel transformer, is mounted at the rear of the amplifier. To remove defective transformer, first undo necessary tie-wraps from wiring harness, separate the transformer's six primary and six secondary wires, and disconnect from VB-5. Turn the amplifier upright, and remove transformer cover. The cover is held in place by strips of foam tape affixed to the transformer. Rotating and pulling on the transformer cover will free it for removal. Using a 9/16" socket, remove 4" L hex head bolt from threaded insert in transformer tunnel and lift the transformer out of amplifier. When mounting replacement transformers, use rubber pads provided, be sure not to pinch wire bundles between transformer and tunnel, tighten bolt securely, and check that transformer cover fits snugly to minimize vibration. Refer to M.A.L. drawing #75-3207-00-00-00 and reconnect all wires to VB-5. Replace tie-wraps on transformer wiring harness.

10.0 Front plate is affixed to amplifier chassis by screws through false front and front plate that are tightened into front handles. Both channels must be removed to gain access to these screws.

10.1 With amplifier upright, unhook red and black HF-2.5 wires from chassis mounted capacitors. This will allow maximum flexibility when separating channel from chassis.

10.2 Turn amplifier upside down and rest false front, but not front plate, on edge of work surface. Amplifier will eventually be supported by false front and rear panel only. Disconnect red and yellow 22 awg wires from front of VB-5 PC assembly and carefully route them through hole in transformer tunnel.

10.3 Using large blade screwdriver, remove four 10-32 screws securing rail bars to filter capacitors. Carefully remove lockwashers from screws and set aside.

10.4 Using 9/64" Allen driver remove 8-32 machine screws securing channel heatsink to false front and rear panel. Channels may now be moved away from amplifier frame.

10.5 Using 5/32" Allen driver, remove two 10-32 machine screws and lockwashers tightened into each front handle. Hold front plate in place as last screw is removed, then lower the plate gently.

10.6 Remove one 4-40 X 3/8" screw and lockwasher securing LED PC assembly to back of frontplate and install screw, washer, spacer and PC assembly in new frontplate. Check alignment of LED bezel with surface of frontplate and, if necessary, desolder LED, realign and resolder.

10.7 Route red and yellow 22 awg wires through large rectangular hole in false front and position frontplate around power switch. Install 10-32 machine screws and lockwashers and thread loosely into fronthandles. When all four screws are fingertight, check alignment of frontplate with power switch, false front bottom edge, and check that no wires are pinched between false front and frontplate. Tighten screws in place. Route red and yellow 22 awg wires through hole in transformer tunnel and reconnect to VB-5 assembly.

11.0 Several wiring details should be followed closely to ensure consistent and optimum electrical performance of the No. 27 amplifier. See drawings D, E and F when reconnecting the audio channel to the chassis.

11.1 Refer to Drawing E and solder three wires from shielded input cable to AC-3 terminals. Sleeve each wire connection with 1/8" dia X 1/2" L black heatshrink.

11.2 Using 10-32 brass screw and two lockwashers for each connection, attach HF-10 output cables to audio channel and tighten in place as shown in drawing D.

11.3 Using 6-32 brass screw and one lockwasher against PC mounted post, attach HF-2.5 supply cables to audio channel and tighten in place as shown in drawing E.

11.4 Attach seven-pin connector to OL-3 pin carrier and fold channel gently onto amplifier chassis. Route HF-2.5 wires behind chassis mounted supply capacitors, tuck shielded input cable in place, check that no wires are pinched between heatsink and chassis, and loosely install four 8-32 machine screws into front and rear panels. Refer to drawing G for preferred routing of all wires prior to final connections to audio channel.

11.5 Using 10-32 brass screw and two lockwashers per connection, attach 14 awg red and black wires and channel rail bars to chassis mounted supply capacitors. Some slight shifting of channel and/or rail bars may be necessary to ensure proper alignment; be careful not to cross-thread terminal of capacitor. Torque rail bar screws to 24 inch-pounds maximum.

11.6 Fold rear panel up so that four 8-32 buttonhead screws can be loosely threaded into tapped holes in transformer tunnel. Check for clearance of all wires and tighten.

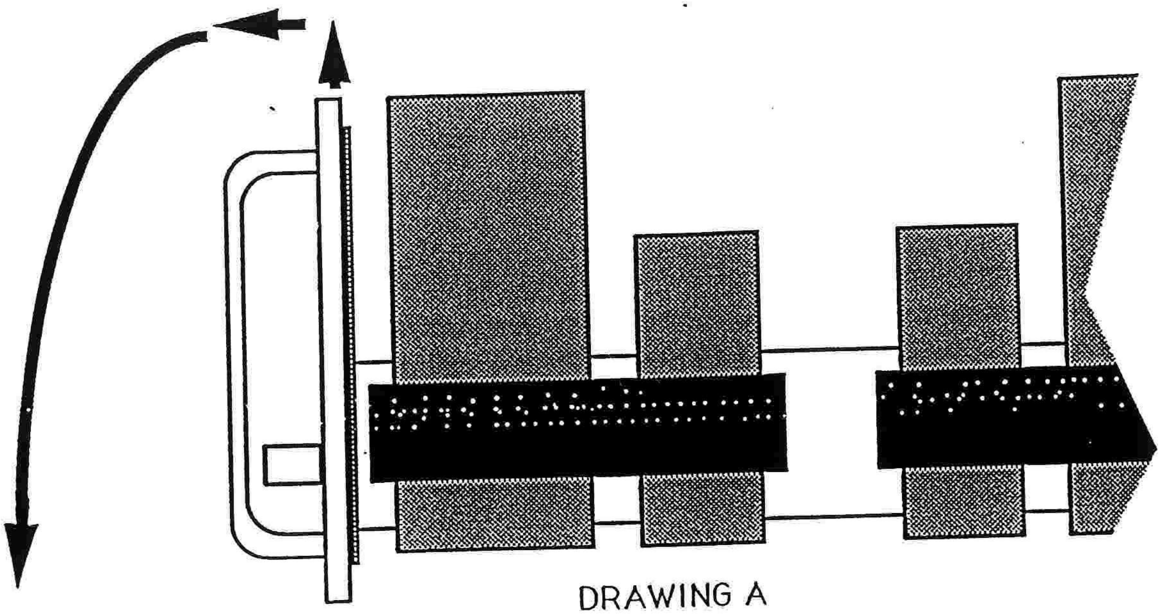
11.7 Using 1/8" dia. X 1/2"L black heatshrink on each connection, resolder four wires from shielded input cable to OL-3 PC assembly. Refer to drawing C for proper connections and routing. Clean all connections with flux remover and shrink tubing in place.

11.8 Reinstall two 8-32 machine screws through each channel heatsink and thread into rear panel.

11.9 Check alignment and tighten all hardware.

12.0 Using 5/64" Allen driver, loosely install twelve 6-32 buttonhead screws through bottom plate into amplifier chassis. Before tightening, bottom plate should be checked for clearance with four heatsink covers and aligned with edge of frontplate.

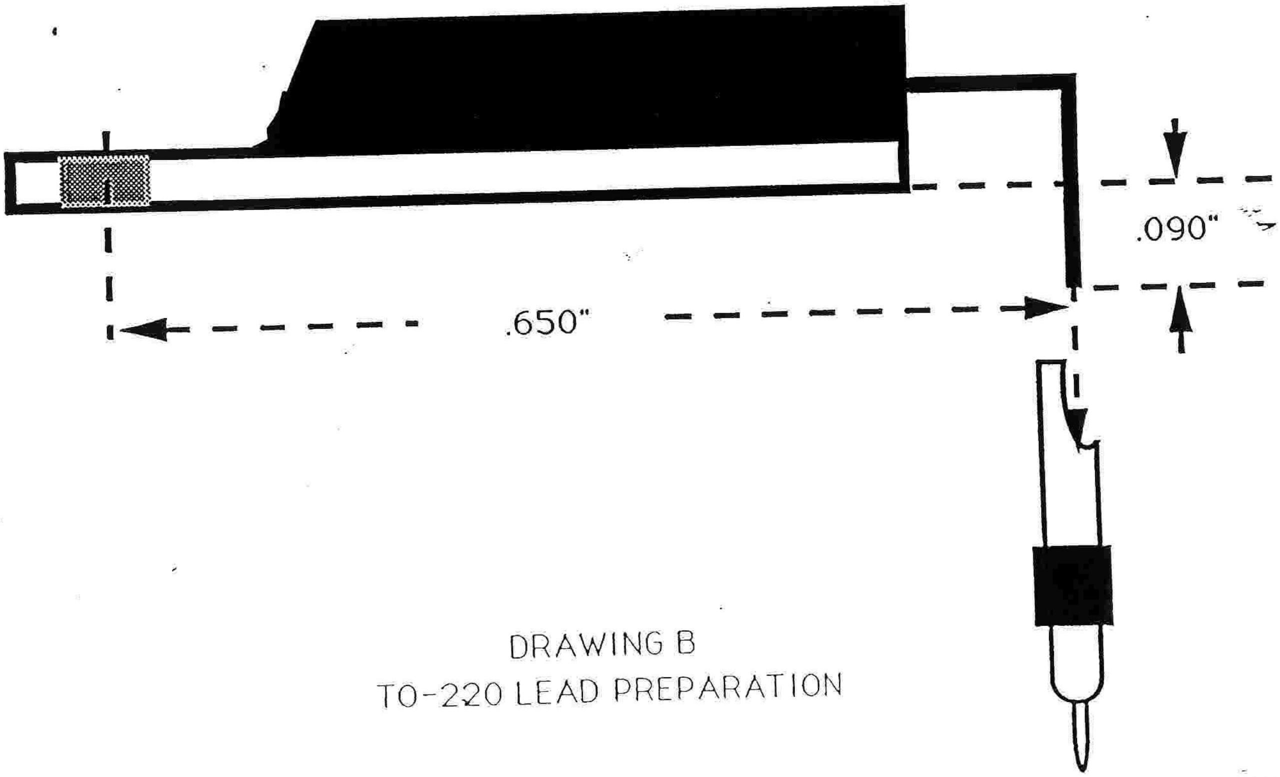
12.1 Using 5/64" Allen driver, loosely install twelve 6-32 buttonhead screws through top plate into amplifier chassis. Before tightening, top plate should be checked for clearance with four heatsink covers and aligned with edge of frontplate.



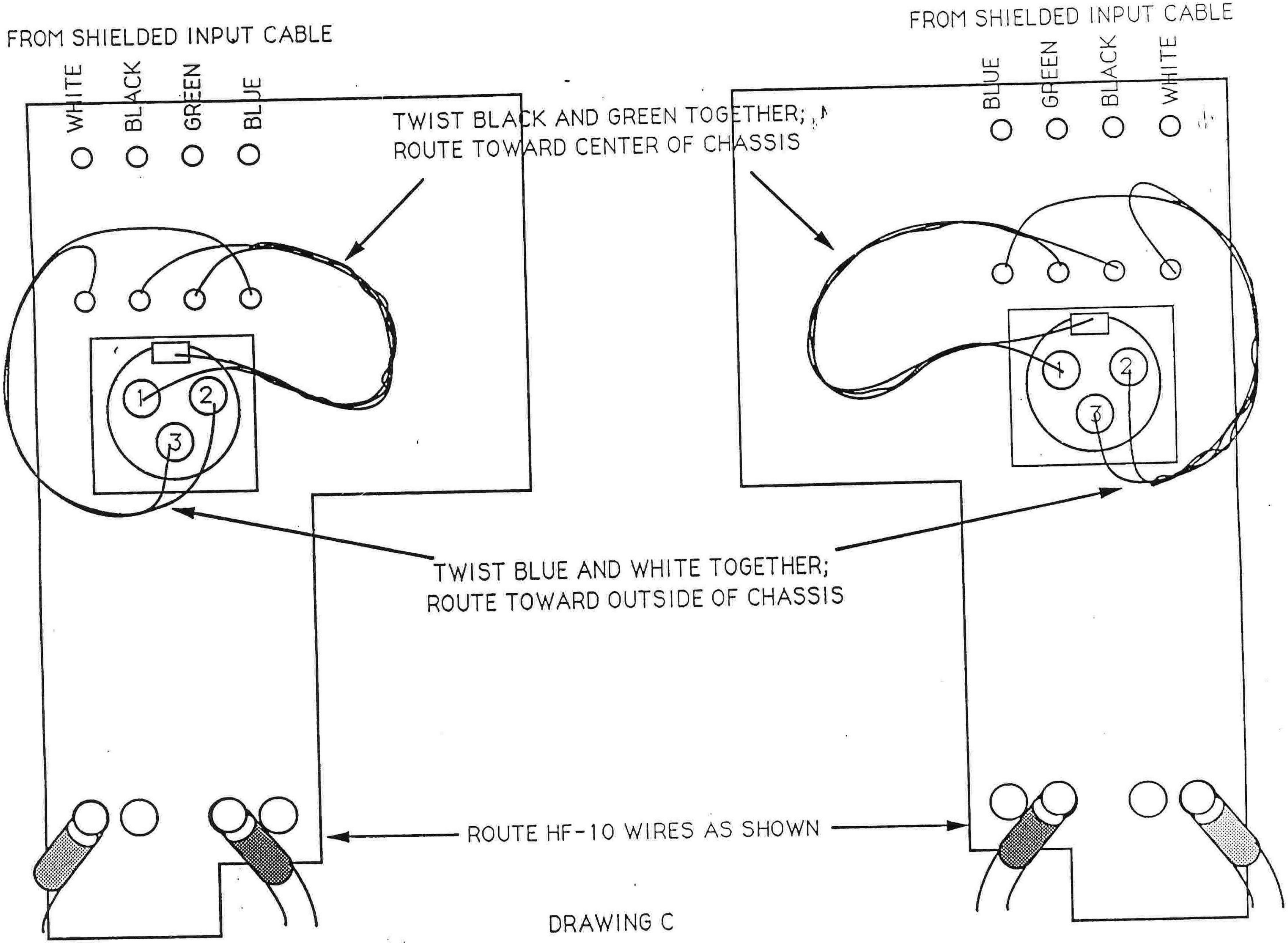
1.) PULL REAR PANEL
UP SLIGHTLY
2.) PULL PANEL
STRAIGHT BACK
3.) DROP PANEL

DRAWING A

NO.27 SIDE VIEW



DRAWING B
TO-220 LEAD PREPARATION


FROM SHIELDED INPUT CABLE
WHITE
BLACK
GREEN
BLUE
1
2
3
FROM SHIELDED INPUT CABLE
BLUE
GREEN
BLACK
WHITE
1
2
3

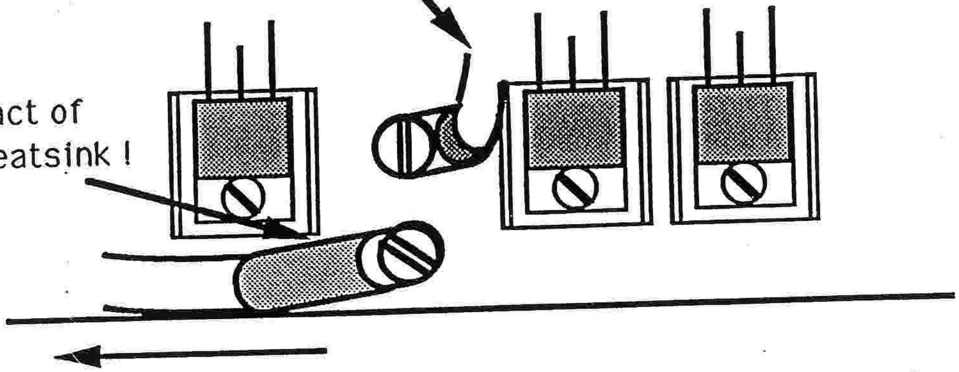
TWIST BLACK AND GREEN TOGETHER;
ROUTE TOWARD CENTER OF CHASSIS

TWIST BLUE AND WHITE TOGETHER;
ROUTE TOWARD OUTSIDE OF CHASSIS

ROUTE HF-10 WIRES AS SHOWN

DRAWING C

NO.27 REAR PANEL INNER VIEW



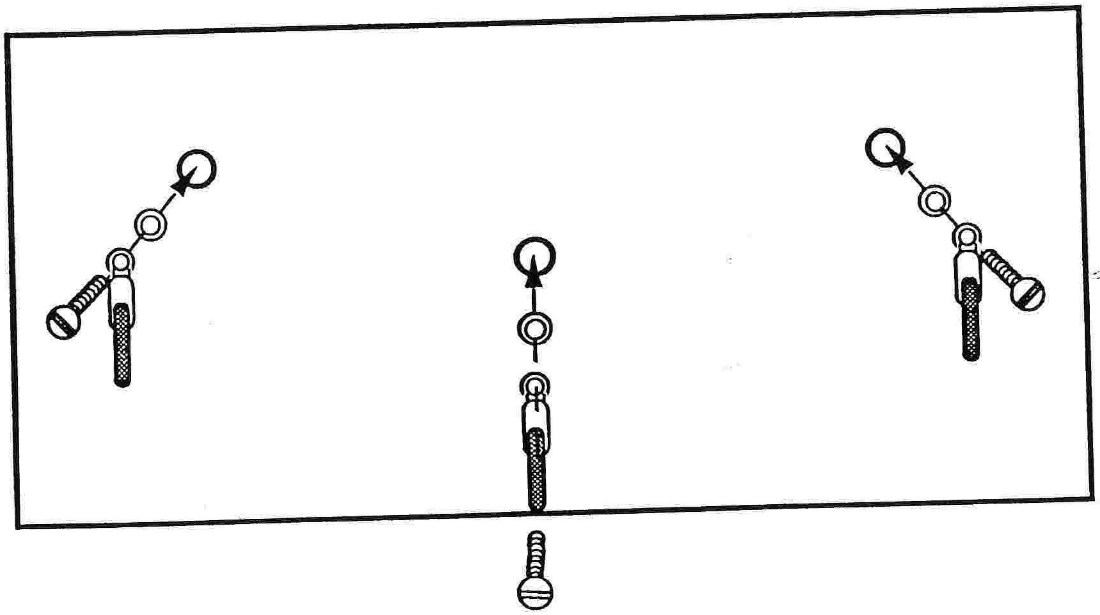
ROUTE BLACK HEATSHRUNK HF-10 IN THIS DIRECTION FOR BOTH CHANNELS

avoid contact of wire and heatsink !

ROUTE RED HEATSHRUNK HF-10 IN THIS DIRECTION FOR BOTH CHANNELS

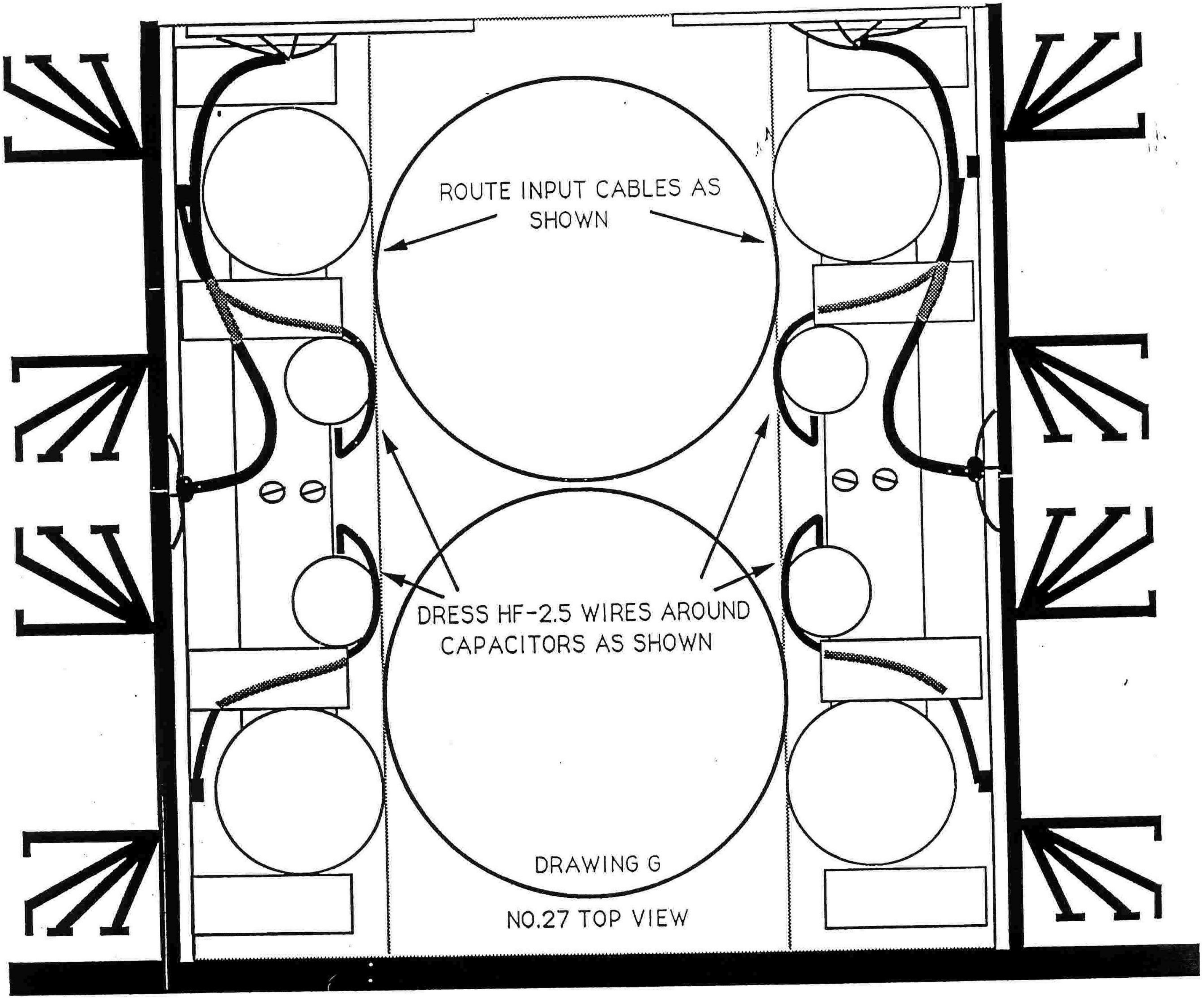
DRAWING D

NO.27 AC-3 OUTPUT CONNECTION WIRE DRESS

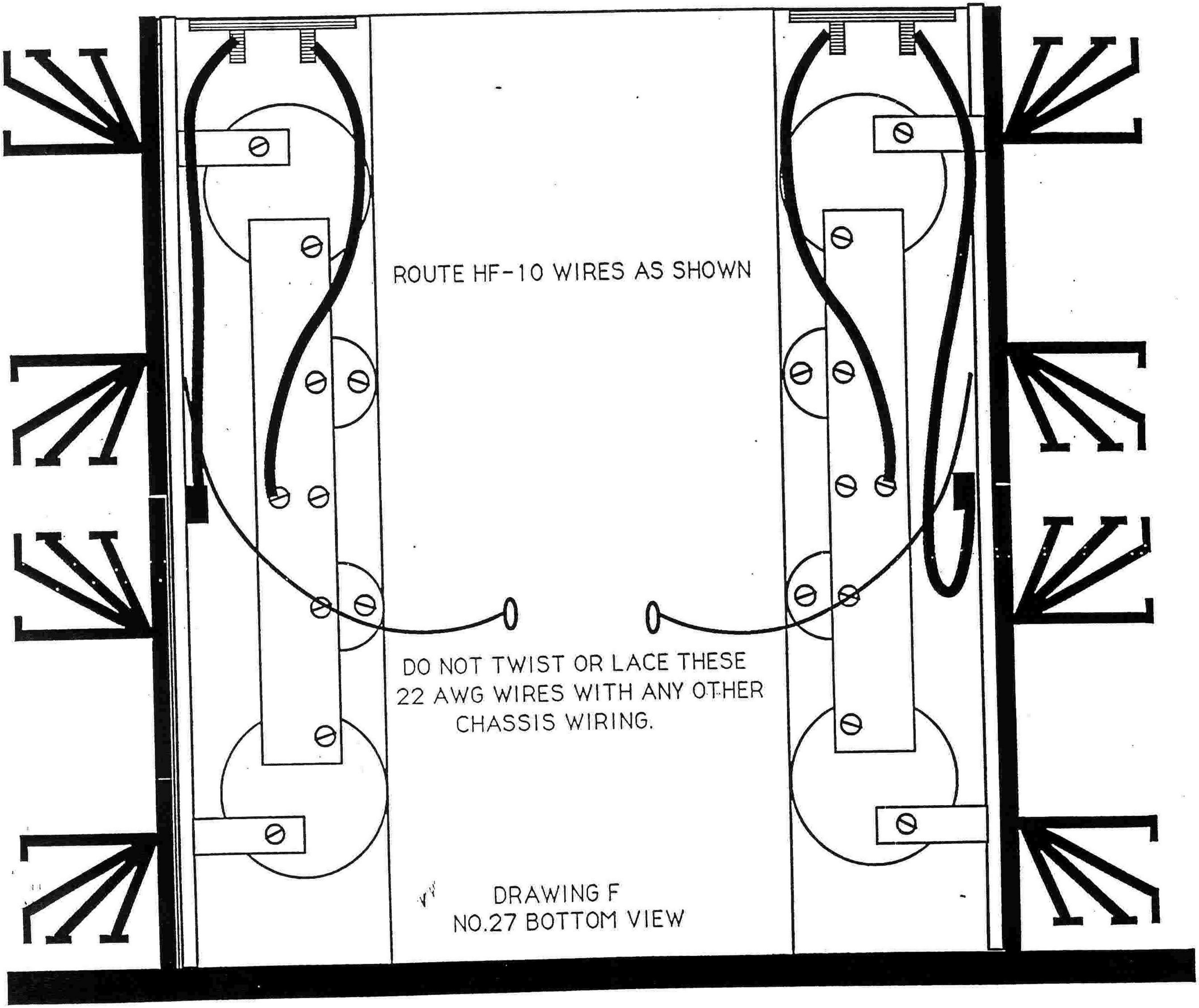


DRAWING E

NO.27 HF-2.5 SUPPLY WIRE DRESS


ROUTE INPUT CABLES AS SHOWN
DRESS HF-2.5 WIRES AROUND CAPACITORS AS SHOWN
DRAWING G

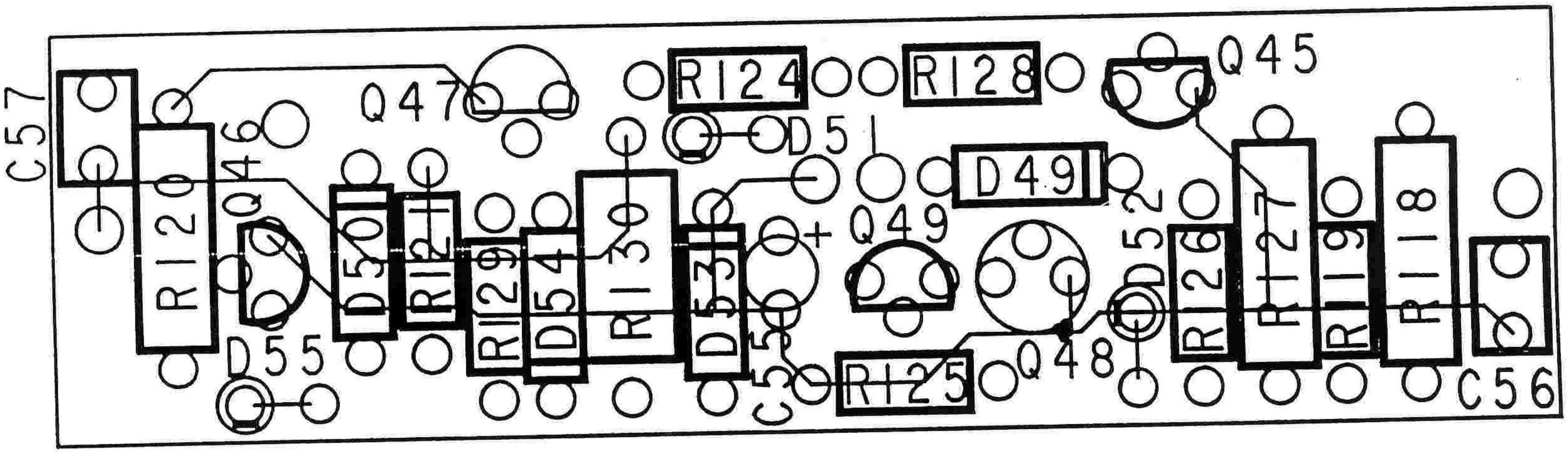
NO.27 TOP VIEW



ROUTE HF-10 WIRES AS SHOWN

DO NOT TWIST OR LACE THESE 22 AWG WIRES WITH ANY OTHER CHASSIS WIRING.

DRAWING F
NO.27 BOTTOM VIEW


C57
R120
Q46
Q47
D55
D50
R121
R129
D54
R130
D53
C55
R124
D51
R128
D49
+
Q49
R125
Q48
Q45
D52
R126
R127
R119
R118
C56

MADRIGAL audio laboratories, inc.
2081 South Main Street Middletown Connecticut, 06457

ISSUE	REVISION	DATE	SCALE

TOLERANCES
UNLESS SPECIFIED
FRACTION ± .010
DECIMAL ± .005
ANGLE ± 1/2°

DR. A.M.
DATE 4-11-89
CH.
DATE

MATERIAL
PCB #30-2701-00

USED IN
No-27

NAME
AT-2

SHEET	OF	SIZE A

A	B	C	D	E	R

NO. AC
75-3208-00-00-00

No27 Shut off problem

Replace these parts on both CG boards regardless of symptom:

D10	Sub. 2x 1N5363	Part # 300-700064 in series. Mount ½ inch above PCB
Q20	Transistor, MJE15030	Part # 310-720069A
Q13, Q19	Transistor, MJE15031	Part # 310-720070A
C52, C53	Capacitor, 68uF	Part # 240-200013
R28, R29, R37	Resistor, 6K34	Part # 203-100281
C201, C202	Capacitor, 22uF	Part # 240-200228

Mandatory (replace these even on a good amplifier)

Resistor (for power relay) 30R	Part # 204-110046
Capacitor (for power relay) 100uF/100V	Part # 240-200282
Surge resistors 10R/10W	Part # 204-110087
LED drive resistor 11K/2W	Part # 203-100383

Other common replacement parts:

510-330023	Camac input connector
490-330092	XLR input connect
510-330785	RCA retrofit jack (in place of Camac connector)
630-460080	Plastic sleeve for Camac connector.
240-200002	10uF/50v capacitor on VSMB
240-200058	45,000uF Electrolytic capacitor
240-200047	1,900uF Electrolytic capacitor
240-200063	680uF capacitor
240-200280	220uF capacitor
203-100383	11K/3W resistor for LED
430-710004	LED
600-350070	Fuse holder
440-350062	15A Fuse
635-420220	Heatsink Stand-off
640-420083	Heatsink Cover Thumbscrew
640-420101	Cover screws
201-150002	Trimpot, 200R
201-150003	Trimpot, 2K

No. 27 Subassembly listing

022-LA2704	ML 27 A&T H/S AC3	2
023-LA2703	ML 27 A&T PCBD AC3	1
023-LA2717	ML 27 ASSY AC-D3 PCBD LOWER LE	1
023-LA2716	ML 27 ASSY PCBD AT2	1
022-LA2715	ML 27 A&T CH W/PWR SUPPLY	1
023-LA2700	ML 27 ASSY PCBD VB5	1
023-LA2701	ML 27 A&T PCBD OL3L	1
023-LA2702	ML 27 A&T PCBD OL3R	1

NO27

NOTES:

1.PRIMARIES - 100, 120, 200, 220, 240 VOLT sine wave, 50/60 Hz
voltage balance - 20V windings + or - 2 %
100V windings + or - 5%

2.SECONDARY VOLTAGE - + or - 3% each winding
voltage balance - + or - 2%

3.REGULATION - All 62 V 500 mA windings 8% or better, no load to full load
All 46 V 7.2 A windings 4% or better, no load to full load

4.LEADS - Stranded, hi temp PVC, colors as noted to differentiate windings and phase
Length 18 "

5.APPROVALS - Must be capable of passing VDE 0551, SEV and UL

6.INSULATION - Primary to secondary 2.5Kv RMS, 60 Hz, 1 minute
100 Megohgm at 500v DC at 25 C

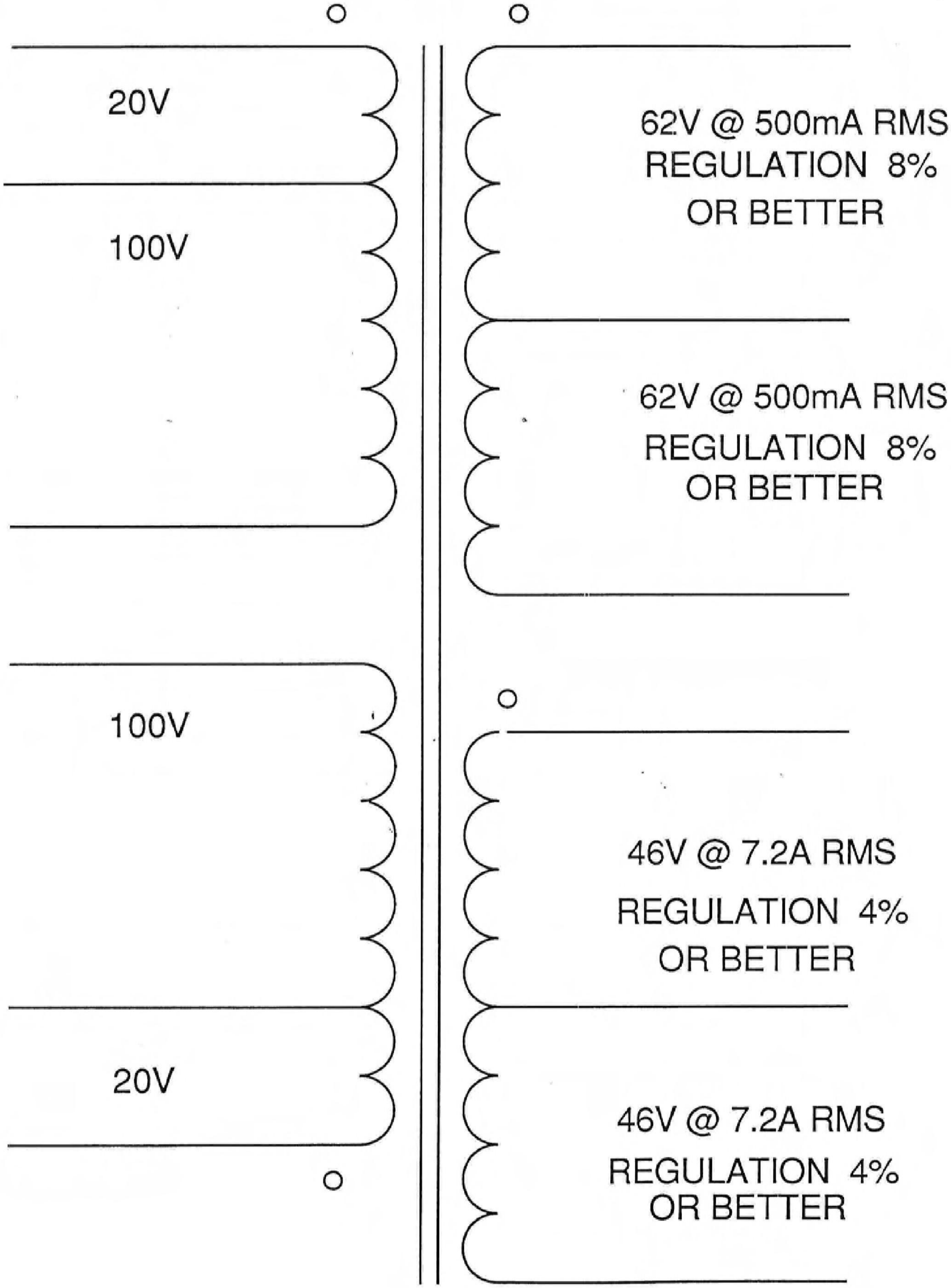
7.TEMPERATURE RISE (25 C ambient) - 40 C

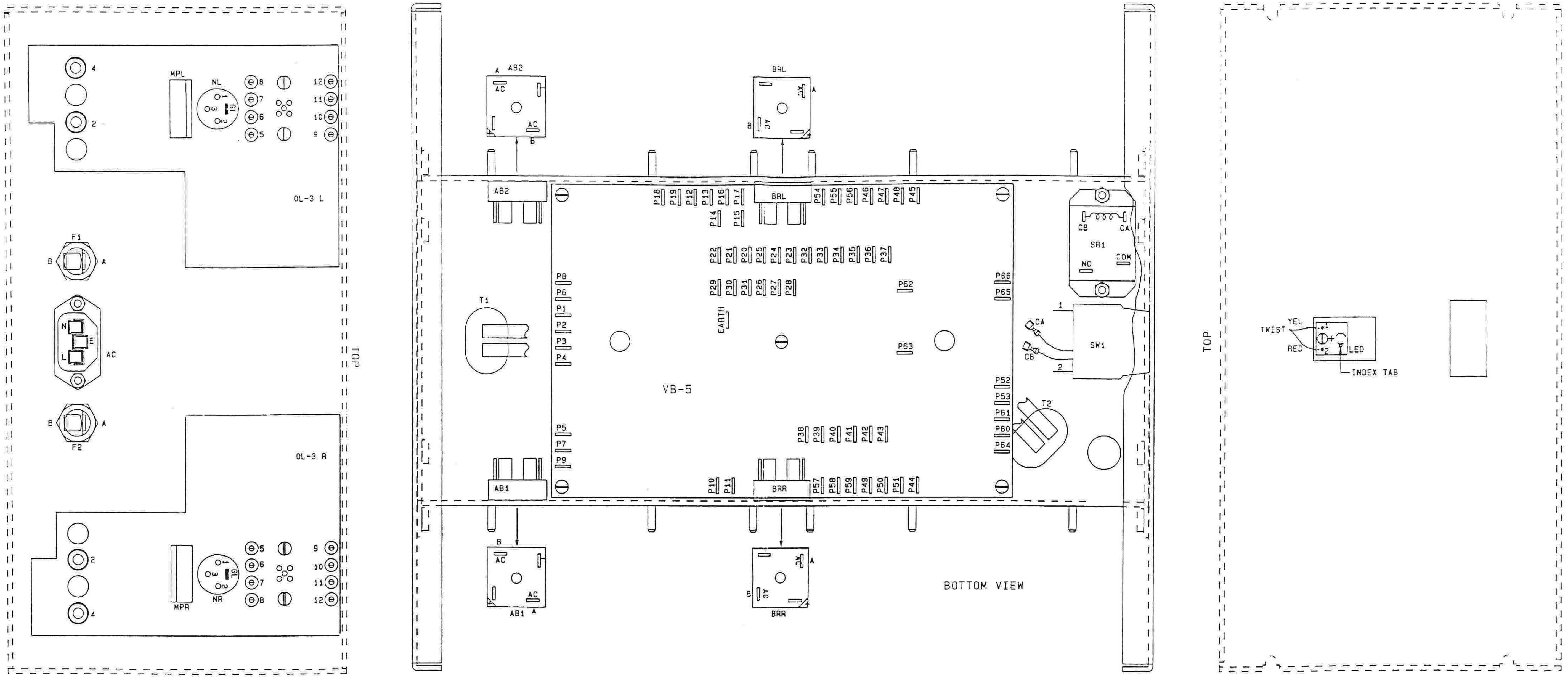
8.CONSTRUCTION - Wind for absolute minimum stray magnetic fields. Acoustical noise must be inaudible after potting at 1 meter, full load, asymmetrical AC line.

Lead breakout - 1 position

Black PVC sheath on bundle 4 " long

NO CHANGES TO THE SPECIFICATIONS PERFORMANCE, MATERIALS, APPEARANCE ETC. OF THIS PART MAY BE MADE BY THE VENDOR UNLESS MADE KNOWN TO AND APPROVED BY MADRIGAL AUDIO LABORATORIES ENGINEERING.


20V
100V
100V
20V
62V @ 500mA RMS
REGULATION 8%
OR BETTER
62V @ 500mA RMS
REGULATION 8%
OR BETTER
46V @ 7.2A RMS
REGULATION 4%
OR BETTER
46V @ 7.2A RMS
REGULATION 4%
OR BETTER



STEP	FROM	TO	COLOR	LENGTH	GAUGE	TERM
1	AB1 POS	AB1 NEG	BLK	4"	14	F/RF
	AB1 A	VB-5, P7	GRY	3 1/2"	14	F/F
	AB1 B	VB-5, P9	RED	5"	14	F/RF
2	AB2 POS	AB2 NEG	WHT	4"	14	RF/RF
	AB2 A	VB-5, P6	GRY	2 1/2"	14	F/F
	AB2 B	VB-5, P8	RED	3"	14	F/F
3	BRR POS	C8 POS	RED	6 1/2"	14	F/RT
	BRR NEG	C5 NEG	BLK	7"	14	RF/RT
	BRR A	VB-5, P51	WHT	4 3/4"	14	F/RF
	BRR B	VB-5, P49	YEL	4 3/4"	14	F/RF
4	BRL POS	C1 POS	RED	7 1/2"	14	RF/RT
	BRL NEG	C4 NEG	BLK	7"	14	F/RT
	BRL A	VB-5, P48	YEL	4 3/4"	14	F/RF
	BRL B	VB-5, P46	WHT	4 3/4"	14	F/RF
5	F1 A	VB-5 P3	BLK	5"	14	F/RF
	F2 A	VB-5, P1	WHT	5"	14	F/RF
6	SW1 1	VB-5, P4	RED	13"	14	F/RF
	SW1 2	VB-5, P5	BLK	13 1/2"	14	F/RF
	SW1 A	VB-5, P65	WHT	5 1/4"	22	F/NA
	SW1 B	VB-5, P66	WHT	5 1/4"	22	F/NA
7	SR1 COM	VB-5, P10	BLU	10 1/2"	14	F/F
	SR1 N.O.	VB-5, P11	YEL	11"	14	F/F
	SR1 CA	VB-5, P52	BLK	6"	22	F/187F
	SR1 CB	VB-5, P53	BLK	6"	22	F/187F
8	AC, L	F1, B	BLK	2 3/4"	14	S&S/RF
	AC, N	F2, B	WHT	2 3/4"	14	S&S/RF
	AC, E	VB-5, P2	GRN	4 3/4"	14	S&S/RF
9	LED, 1	VB-5, P60	RED	11 1/2"	22	S/F
	LED, 2	VB-5, P61	YEL	11 1/2"	22	S/F

C1 POS
C4 NEG
VB-5, P48
VB-5, P46
CONNECTIONS TO BE MADE AT A LATER TIME

STEP	FROM	TO	COLOR	LENGTH	GAUGE	TERM	
10	T1 PRI	VB-5, P22	WHT	8"	16	F	
	T1 PRI	VB-5, P21	BRN	8"	16	F	TWIST
	T1 PRI	VB-5, P20	BLK	8"	16	F	
	T1 PRI	VB-5, P23	BLU	9 1/2"	16	F	
	T1 PRI	VB-5, P24	VIO	9 1/2"	16	F	TWIST
	T1 PRI	VB-5, P25	GRY	9 1/2"	16	F	
	T1 PRI	VB-5, P32	YEL	10"	16	F	
	T1 PRI	VB-5, P33	GRY	10"	16	F	TWIST
	T1 PRI	VB-5, P34	OR	10"	16	F	
	T1 PRI	VB-5, P35	RED	11"	14	F	
	T1 PRI	VB-5, P36	BLK	11"	14	F	TWIST
	T1 PRI	VB-5, P37	GRN	11"	14	F	
11	T2 PRI	VB-5, P28	WHT	9 1/2"	16	F	
	T2 PRI	VB-5, P27	BRN	9 1/2"	16	F	TWIST
	T2 PRI	VB-5, P26	BLK	9 1/2"	16	F	
	T2 PRI	VB-5, P29	BLU	10"	16	F	
	T2 PRI	VB-5, P30	VIO	10"	16	F	TWIST
	T2 PRI	VB-5, P31	GRY	10"	16	F	
	T2 PRI	VB-5, P38	YEL	8 1/2"	16	F	
	T2 PRI	VB-5, P39	GRY	8 1/2"	16	F	TWIST
	T2 PRI	VB-5, P40	OR	8 1/2"	16	F	
	T2 PRI	VB-5, P41	RED	7"	14	F	
	T2 PRI	VB-5, P42	BLK	7"	14	F	TWIST
	T2 PRI	VB-5, P43	GRN	7"	14	F	
12	NL, GL	OL-3L, 6	GRN		22	S&S	
	NL, 1	OL-3L, 7	BLK		22 SILVER	S&S	
	NL, 2	OL-3L, 8	WHT		22 SILVER	S&S	
	NL, 3	OL-3L, 5	BLU		22 SILVER	S&S	
13	NR, GL	OL-3R, 6	GRN		22	S&S	
	NR, 1	OL-3R, 7	BLK		22 SILVER	S&S	
	NR, 2	OL-3R, 8	WHT		22 SILVER	S&S	
	NR, 3	OL-3R, 5	BLU		22 SILVER	S&S	

ORIGINAL IN RED
☒ Part# LA2715/LA2719
OR
☒ Print# 940143
Release date: 5-5-92
Type of release: ☐ Prototype ☐ Pilot ☐ 1st production ☐ Revision
Comments:
Drafting approval: Engineering approval:
Issued by: SIGNATURE Date:

TOLERANCES UNLESS SPECIFIED
FRACTION ± .010
DECIMAL ± .005
ANGLE ± 1/2°

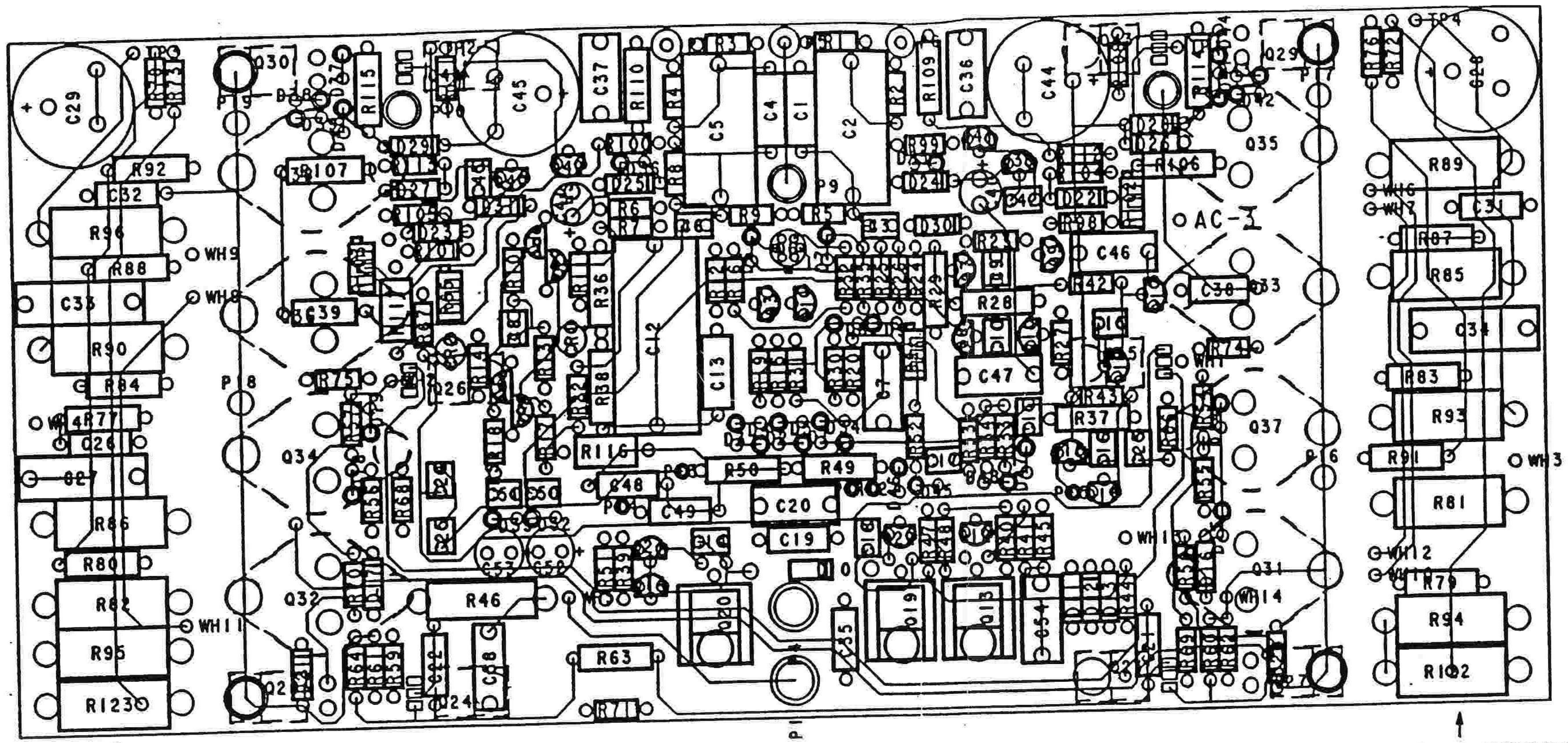
ISSUE	REVISION	DATE

DR. A.M. DATE 4-27-89
CH. DATE
SCALE

MADRIGAL audio laboratories, inc.
2081 South Main Street Middletown Connecticut, 06457

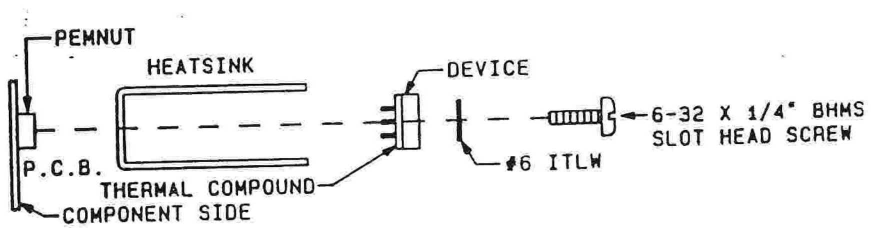
MATERIAL
USED IN No.27/No.27.5
NAME WIRING DIAGRAM
SHEET 1 OF 1 2 SIZE D
A B C D E R
NO. 940143

* ALL MARKED RESISTORS ARE. .1% TOLERANCE.B SUFFIX.
ALL UNMARKED DIODES ARE 1N914B.

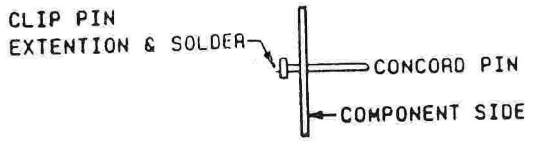

C29
R92
C32
R96
R88
WH9
WH8
C33
R90
R84
R77
C26
C27
R86
R80
R82
WH11
R95
R123
Q30
P19
R107
C39
P18
Q34
Q32
Q21
R115
C45
R100
R36
R46
R63
R71
C37
R110
R3
C5
C4
C1
C2
R109
C36
C44
Q29
P17
Q35
AC-3
C46
C38
Q33
C47
R28
R43
R37
Q37
P16
Q31
WH14
WH1
C12
C13
R116
C48
C49
R50
R49
C20
C19
R6
R7
R9
R5
D29
D27
D23
D25
D30
D24
D22
R106
R98
R42
R74
TP4
C18
R89
WH16
WH17
C31
R87
R85
C34
R83
R93
R91
WH3
R81
WH12
WH10
R79
R94
R102

RAISE ALL WIREWOUND RESISTORS
.062" OFF BOARD.

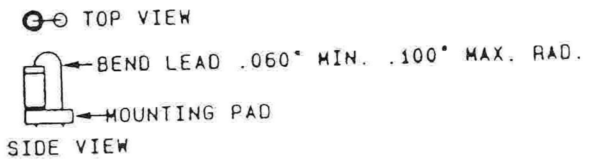
RAISE ALL WIREWOUND RESISTORS
.062" OFF BOARD.


PEMNUT
HEATSINK
DEVICE
6-32 X 1/4" BHMS
SLOT HEAD SCREW
#6 ITLW
P.C.B.
THERMAL COMPOUND
COMPONENT SIDE

TO-220 HEATSINK MOUNTING DETAIL


CLIP PIN
EXTENTION & SOLDER
CONCORD PIN
COMPONENT SIDE

CONCORD PIN DETAIL


TOP VIEW
BEND LEAD .060" MIN. .100" MAX. RAD.
MOUNTING PAD
SIDE VIEW

STANDUP DIODE MOUNTING DETAIL

NOTE:
1 ALL RESISTORS ARE RN60, .25W MIL.
1%, & ARE IN OHMS OR IN CODE
UNLESS INDICATED OTHERWISE.
2 ALL CAPACITORS ARE IN MICROFARADS
OR IN CODE UNLESS INDICATED OTHERWISE.
3 $K=10^3$, $M=10^6$.
4 $m=10^{-3}$, $u=10^{-6}$, $n=10^{-9}$, $p=10^{-12}$.

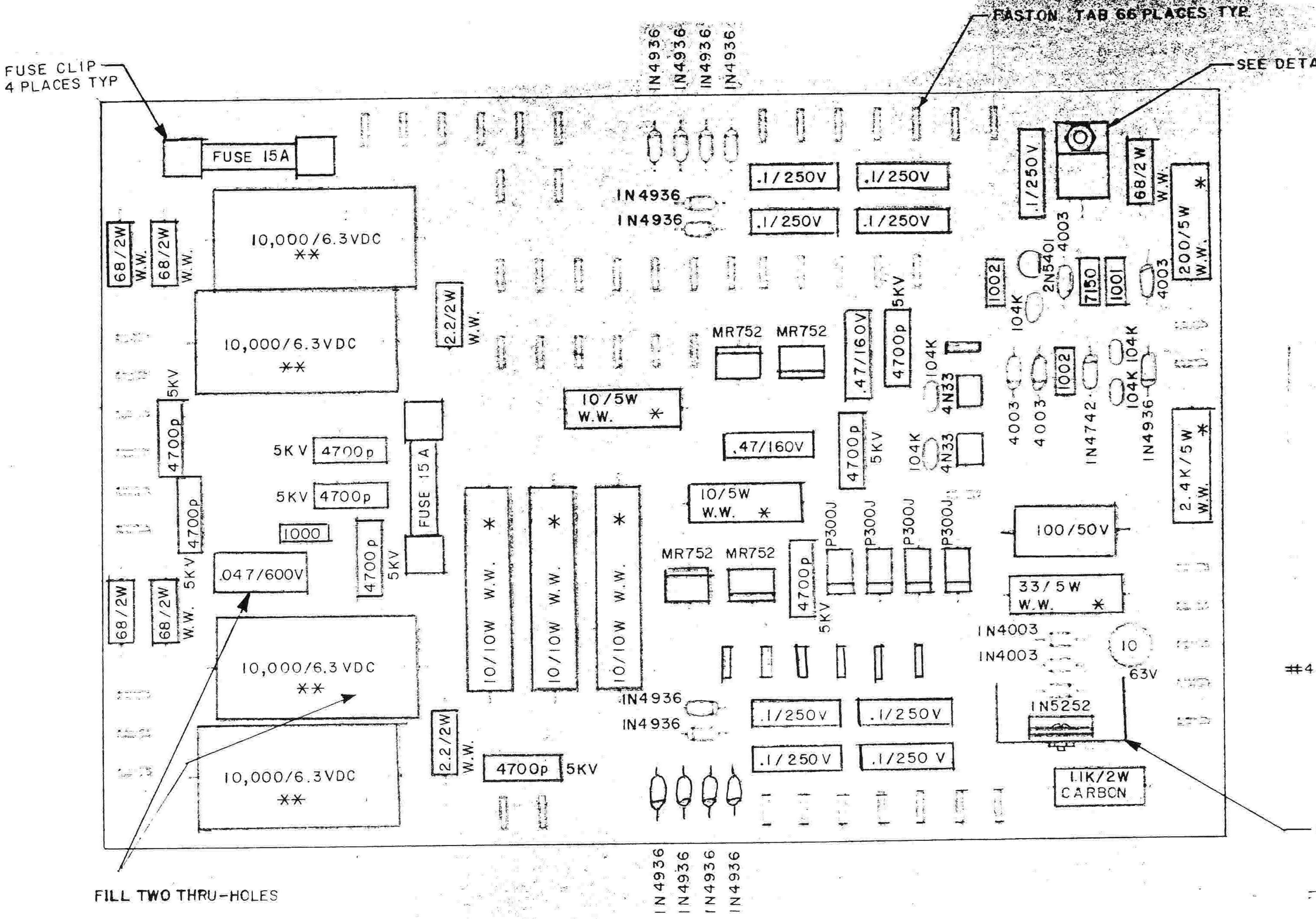
ISSUE	REVISION	DATE

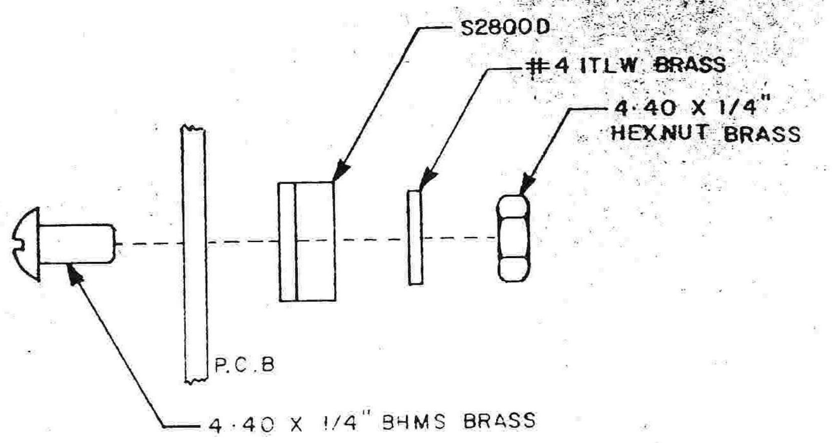
TOLERANCES
UNLESS SPECIFIED
FRACTION ± .016
DECIMAL ± .005
ANGLE ± 1/2°
DR. A.K. DATE 4-4-88
CH. DATE
SCALE

MADRIGAL audio laboratories, inc.
2081 South Main Street Middletown Connecticut, 06457

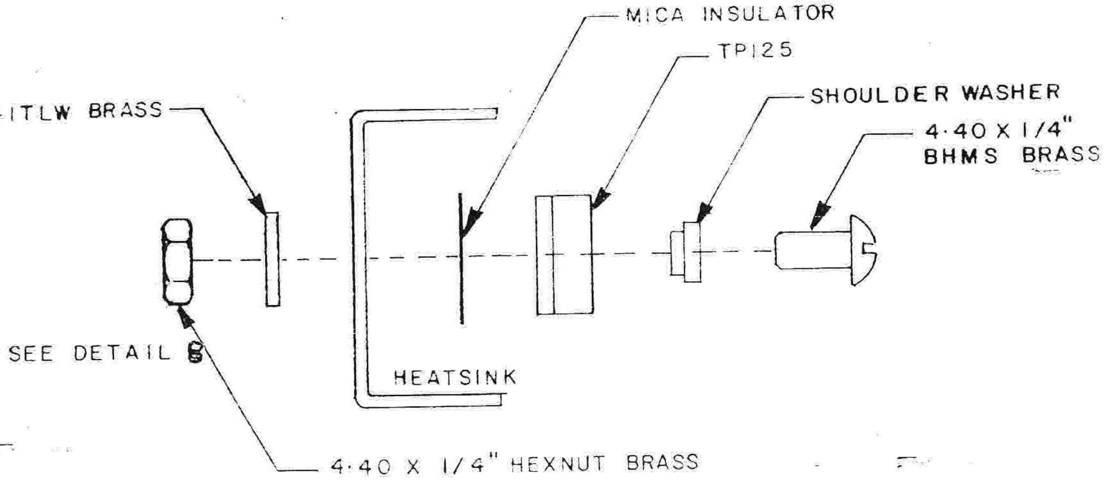
MATERIAL
P.C.B. 30-2700-10
USED IN
NO-27
NAME
AC-3

SHEET OF
SIZE C
A B C D E
NO.
A
75-3203-00-00-00


FASTON TAB 66 PLACES TYP.
SEE DETAIL A
FUSE CLIP 4 PLACES TYP
FUSE 15A
IN4936
IN4936
IN4936
IN4936
.1/250V
10,000/6.3VDC **
68/2W W.W.
2.2/2W W.W.
10/5W W.W. *
MR752
47/160V
4700p 5KV
.47/160V
1000
.047/600V
FUSE 15 A
10/10W W.W. *
P300J
100/50V
33/5W W.W. *
IN4003
10 63V
IN5252
1.1K/2W CARBON
1002
2N5401
4003
7150
1001
200/5W W.W. *
104K
4N33
IN4742
2.4K/5W W.W. *
.1/250V
FILL TWO THRU-HOLES
SEE DETAIL B


S2800D
#4 ITLW BRASS
4·40 X 1/4" HEXNUT BRASS
P.C.B
4·40 X 1/4" BHMS BRASS

DETAIL A


MICA INSULATOR
TP125
SHOULDER WASHER
#4ITLW BRASS
4·40 X 1/4" BHMS BRASS
HEATSINK
4·40 X 1/4" HEXNUT BRASS

DETAIL B

NOTE:

1. ALL RESISTORS ARE RN60, .25W MIL., 1%, & ARE IN OHMS OR IN CODE UNLESS INDICATED OTHERWISE.
2. ALL CAPACITORS ARE IN MICROFARADS OR IN CODE UNLESS INDICATED OTHERWISE.
3. $K=10^3, M=10^6$.
4. $m=10^{-3}, \mu=10^{-6}, n=10^{-9}, p=10^{-12}$.
5. ALL STANDING COMPONENTS ARE TO BE INSTALLED WITH MOUNTING PADS.

* RAISE OFF BOARD.

** PLACE 1.5" GREY TAPE UNDER CAPACITOR.

MADRIGAL audio laboratories, inc.

P.C.B.# 30·2703·10

DR A.L.M. DATE 1·9·89

CH DATE

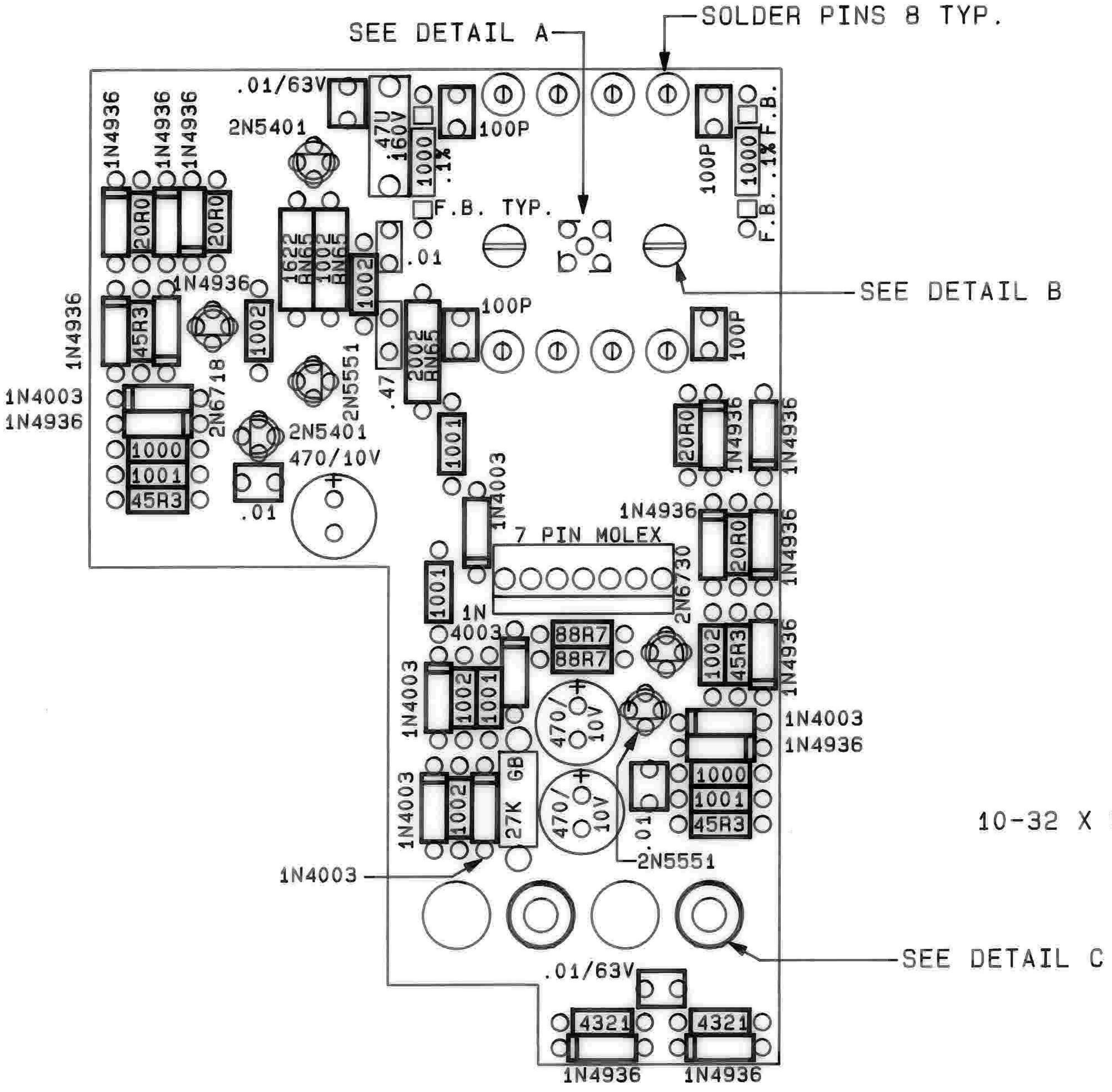
USED IN Nº 27

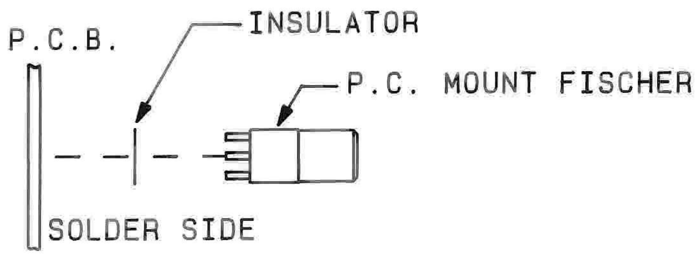
NAM. VB-5

75·3200·00·00·00

ISSUE	REVISION	DATE
	RELEASE	4·5·89

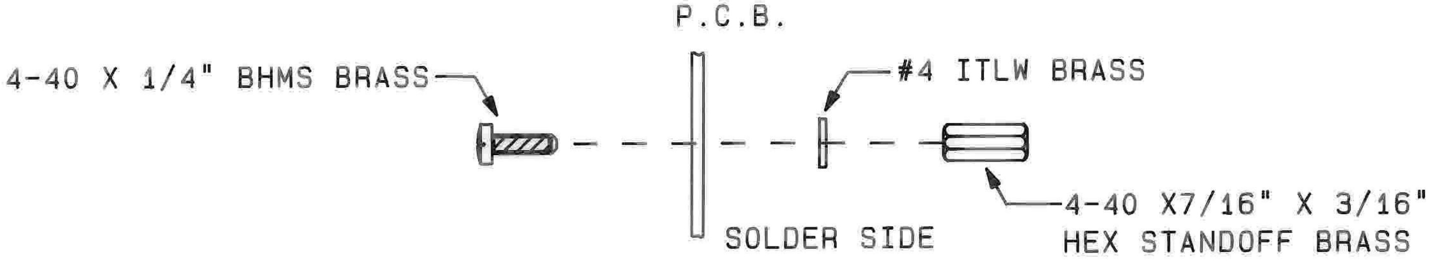
SCALE


SEE DETAIL A
SOLDER PINS 8 TYP.
.01/63V
2N5401
47U 160V
1000 .1%
100P
1N4936
1N4936
1N4936
20R0
20R0
F.B. TYP.
1622 RN65
1002 RN65
1002
.01
1N4936
1N4936
45R3
1002
1N4003
1N4936
1N6718
2N5551
.47
2002 RN65
100P
1000 .1% F.B.
F.B.
SEE DETAIL B
1000
1001
45R3
2N5401
470/10V
.01
1001
1N4003
7 PIN MOLEX
1N4936
20R0
1N4936
2N6730
1001
1N 4003
88R7
88R7
1002
45R3
1N4003
1002
1001
470/10V
1N4003
1N4936
1N4003
1002
27K
6B
.01
2N5551
1000
1001
45R3
1N4003
SEE DETAIL C
.01/63V
4321
4321
1N4936
1N4936

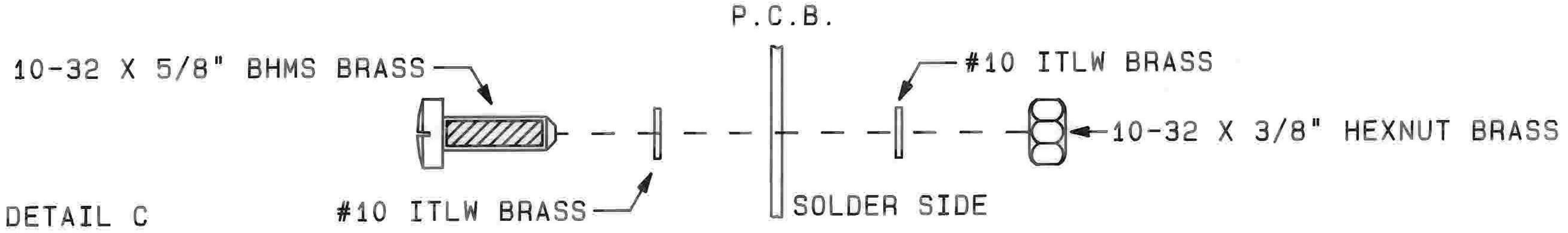

P.C.B.
INSULATOR
P.C. MOUNT FISCHER
SOLDER SIDE

FISCHER MOUNTING DETAIL

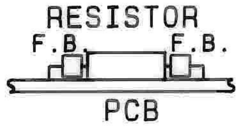
DETAIL A


P.C.B.
4-40 X 1/4" BHMS BRASS
#4 ITLW BRASS
4-40 X7/16" X 3/16"
HEX STANDOFF BRASS
SOLDER SIDE

DETAIL B


P.C.B.
10-32 X 5/8" BHMS BRASS
#10 ITLW BRASS
10-32 X 3/8" HEXNUT BRASS
#10 ITLW BRASS
SOLDER SIDE

DETAIL C


RESISTOR
F.B.
F.B.
PCB

ORIGINAL IN RED
☒ Part# 580181
OR
☒ Print# 940791

Release date:

Type of release: ☐ Prototype ☐ Pilot
☒ 1st production ☒ Revision

Comments: OLD P/N: 30-2702-00-PC-B0

Drafting approval: Engineering approval:
Issued by: Date: 10-22-91
SIGNATURE

ISSUE	REVISION	DATE
A	ADDED RES. DETAIL	10-22

TOLERANCES
UNLESS SPECIFIED
FRACTION ± .010
DECIMAL ± .005
ANGLE ± 1/2°

DR.	DATE
A.M.	11-16-88
CH.	DATE
SCALE	

MADRIGAL audio laboratories, inc.
2081 South Main Street Middletown Connecticut, 06457

MATERIAL

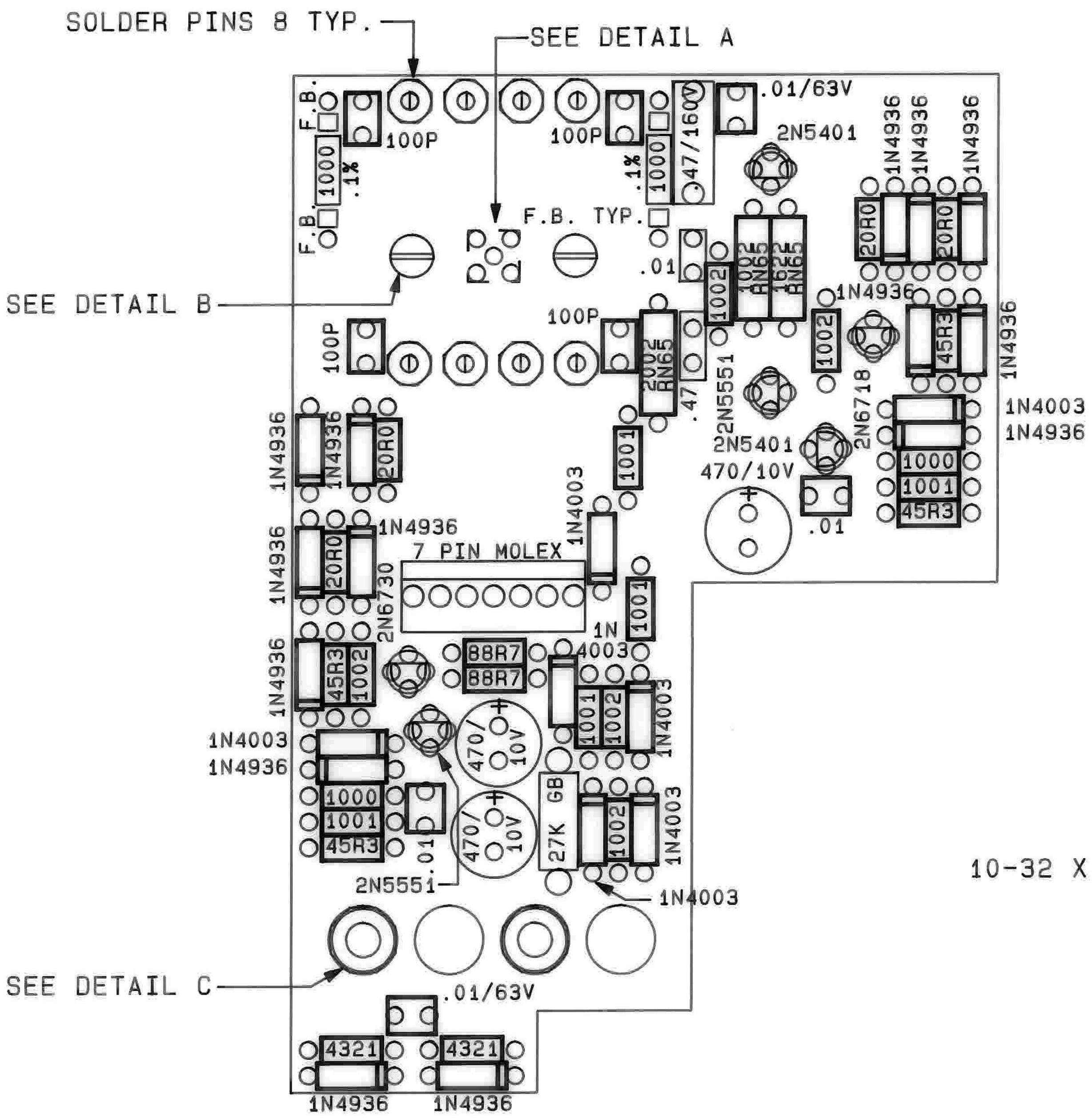
USED IN
No. 27/LA2702

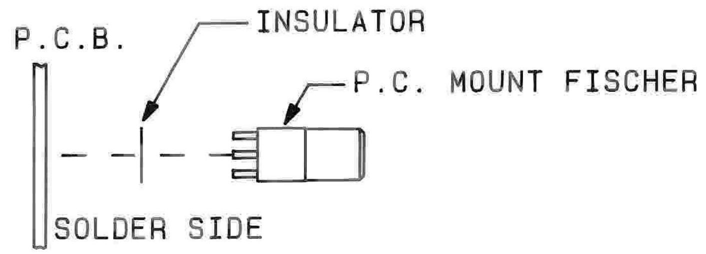
NAME
OL-3 RIGHT ASS'Y NOCODE

SHEET	OF	SIZE
		B

A	B	C	D	E	R
91					

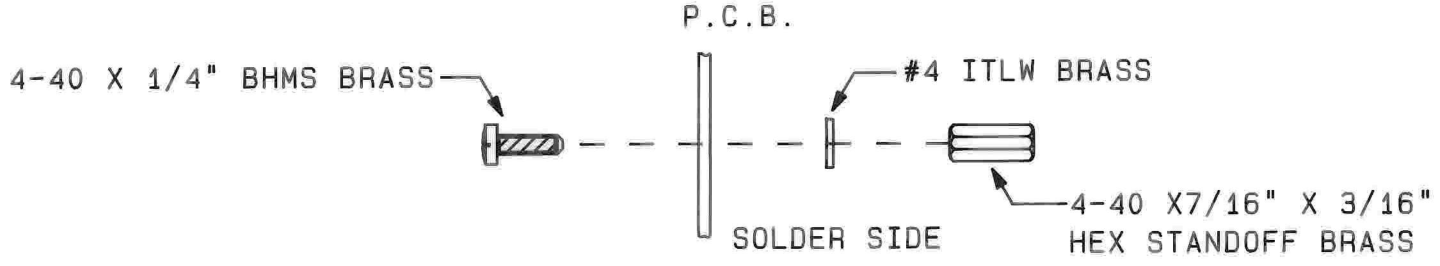
NO. 940791


SOLDER PINS 8 TYP.
SEE DETAIL A
SEE DETAIL B
SEE DETAIL C
F.B.
F.B. TYP.
100P
1000 .1%
.47/160V
.01/63V
2N5401
1N4936
20R0
45R3
1002
.01
RN65
2002
2N5551
2N6718
1N4003
1000
1001
470/10V
7 PIN MOLEX
2N6730
88R7
27K
GB
4321
1N4936

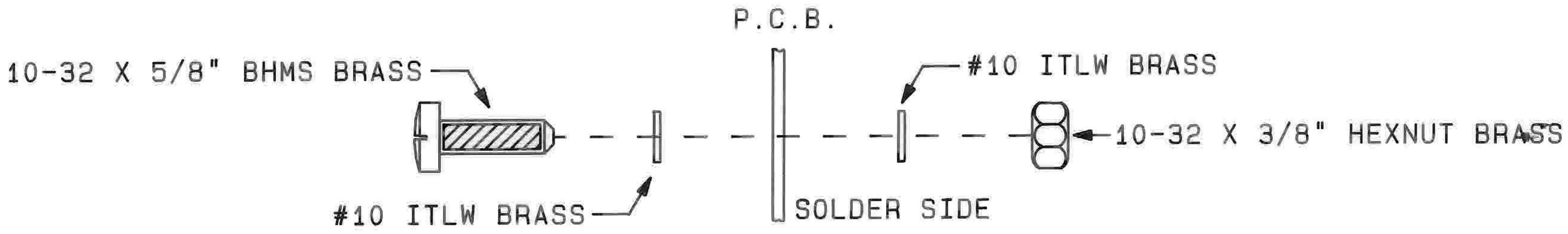

P.C.B.
INSULATOR
P.C. MOUNT FISCHER
SOLDER SIDE

FISCHER MOUNTING DETAIL

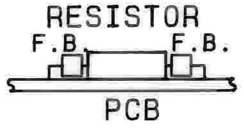
DETAIL A


P.C.B.
4-40 X 1/4" BHMS BRASS
#4 ITLW BRASS
SOLDER SIDE
4-40 X7/16" X 3/16"
HEX STANDOFF BRASS

DETAIL B


P.C.B.
10-32 X 5/8" BHMS BRASS
#10 ITLW BRASS
10-32 X 3/8" HEXNUT BRASS
#10 ITLW BRASS
SOLDER SIDE

DETAIL C


RESISTOR
F.B.
F.B.
PCB

ORIGINAL IN RED

☒ Part# 580181
OR
☒ Print# 940790

Release date:

Type of release: ☐ Prototype ☐ Pilot ☒ 1st production ☒ Revision

Comments: OLD P/N: 30-2702-00-PC-B0

Drafting approval: Engineering approval:

Issued by: SIGNATURE Date: 10-22-91

ISSUE	REVISION	DATE
A	ADDED RES. DETAIL	10-22

TOLERANCES
UNLESS SPECIFIED
FRACTION ± .010
DECIMAL ± .005
ANGLE ± 1/2°

DR. A.M. DATE 11-17-88
CH. DATE
SCALE

MADRIGAL audio laboratories, inc.
2081 South Main Street Middletown Connecticut, 06457

MATERIAL

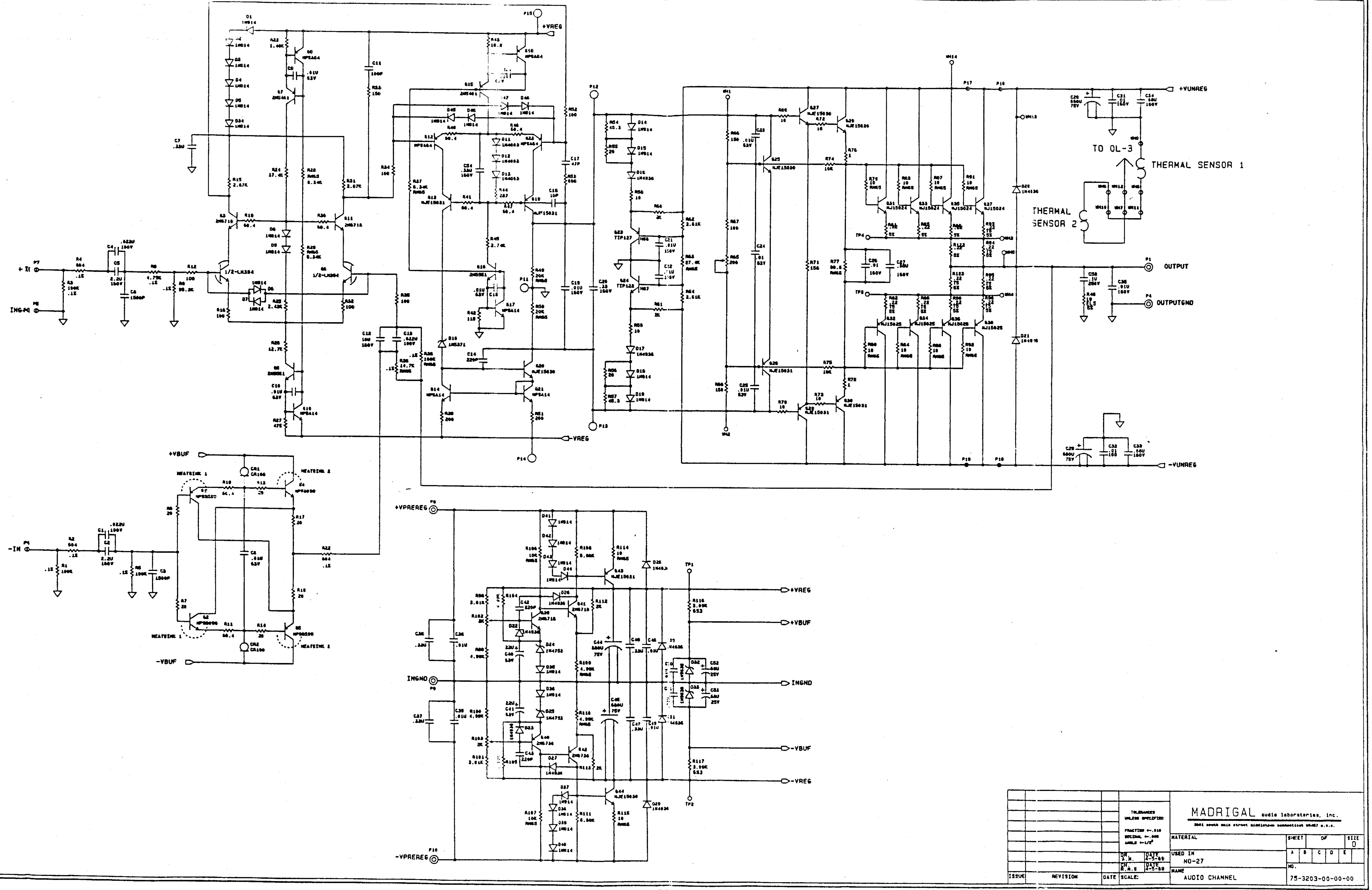
USED IN NO-27 LA2701

NAME OL-3 LEFT ASS'Y NOCODE

SHEET OF SIZE B

A	B	C	D	E	R
91					

NO. 940790


+VREG
+VUNREG
TO OL-3
THERMAL SENSOR 1
THERMAL SENSOR 2
OUTPUT
OUTPUTGND
+IN
ING-IN
-VREG
-VUNREG
+VBUF
HEATSINK 1
HEATSINK 2
-IN
-VBUF
+VPREREG
INGND
-VPREREG
TP1
TP2
+VREG
+VBUF
INGND
-VBUF
-VREG

MADRIGAL audio laboratories, inc.
3041 south main street middletown connecticut 06457 u.s.a.

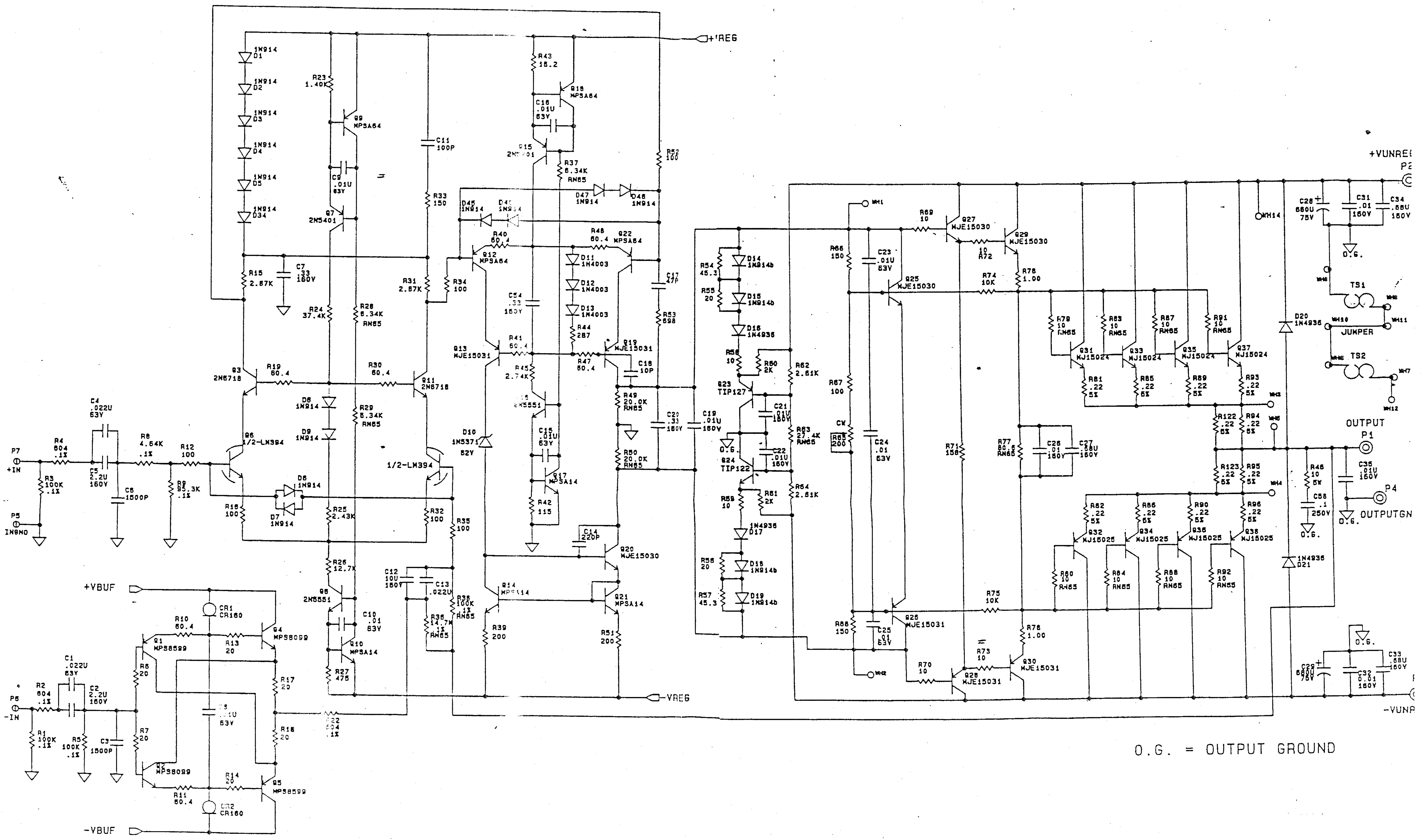
TOLERANCES
UNLESS SPECIFIED
FRACTION +-.010
DECIMAL +-.005
ANGLE +-1/2°

DR. A.M. DATE 4-5-89
CH. R.M.S DATE 4-5-89
SCALE:

ISSUE REVISION DATE

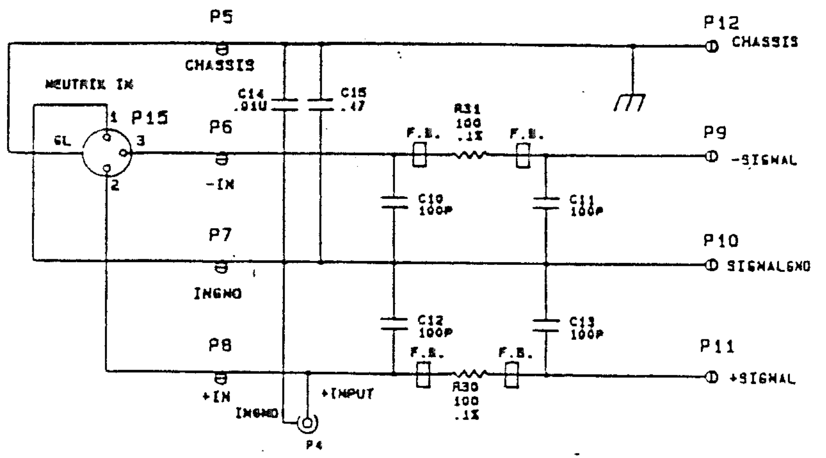
MATERIAL
USED IN NO-27
NAME AUDIO CHANNEL

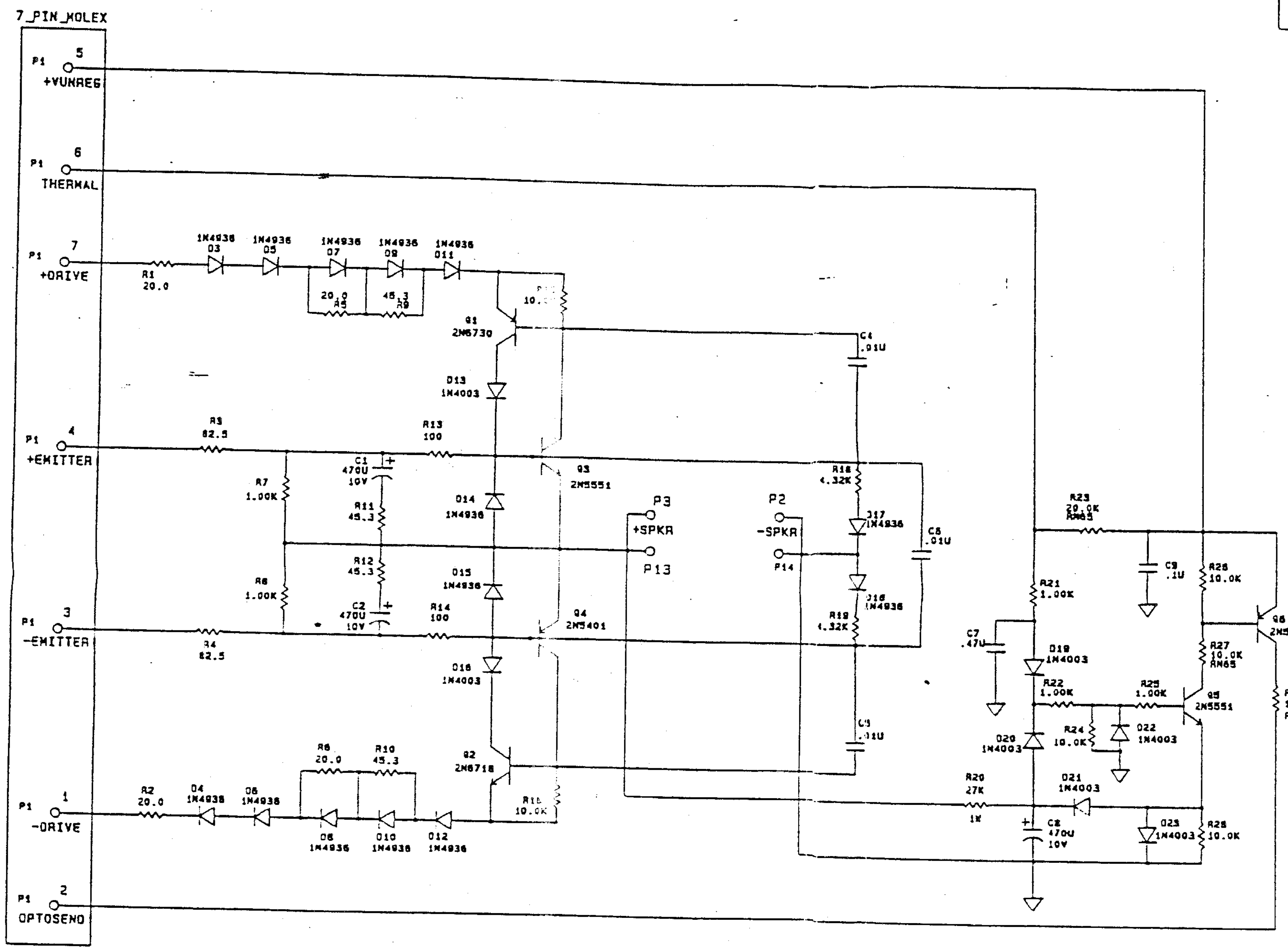
SHEET OF SIZE D
A B C D E
NO. 75-3203-00-00-00


+'REG
-VREG
+VBUF
-VBUF
+VUNRE
P2
-VUNR
P7
+IN
P5
INGND
P6
-IN
OUTPUT
P1
P4
OUTPUTGN
O.G.
JUMPER
TS1
TS2
WH1
WH2
WH14
1N914 D1
1N914 D2
1N914 D3
1N914 D4
1N914 D5
1N914 D34
R23 1.40K
Q9 MPSA64
C9 .01U 63V
Q7 2N5401
C11 100P
R33 150
R43 16.2
Q18 MPSA64
C16 .01U 63V
Q15 2N5401
R37 6.34K RN65
R52 100
D47 1N914
D48 1N914
D45 1N914
D46 1N914
R15 2.87K
C7 .33 160V
R24 37.4K
R28 6.34K RN65
R31 2.87K
R34 100
Q12 MPSA64
R40 60.4
R48 60.4
Q22 MPSA64
D11 1N4003
D12 1N4003
D13 1N4003
R44 287
C54 .33 160V
C17 47P
R53 698
Q13 MJE15031
R41 60.4
R45 2.74K
R47 60.4
Q19 MJE15031
C18 10P
Q3 2N5718
R19 60.4
R30 60.4
Q11 2N5718
D8 1N914
D9 1N914
R29 6.34K RN65
Q16 2N5551
C15 .01U 63V
R49 20.0K RN65
R50 20.0K RN65
C20 .33 160V
C19 .01U 160V
C4 .022U 63V
R4 604 .1%
R8 4.64K .1%
R12 100
Q6 1/2-LM394
1/2-LM394
D10 1N5371 62V
R3 100K .1%
C5 2.2U 160V
C6 1500P
R9 93.3K .1%
D6 1N914
D7 1N914
R16 100
R25 2.43K
R32 100
R35 100
Q17 MPSA14
R42 115
C14 220P
Q20 MJE15030
R26 12.7K
C12 10U 160V
C13 .022U
R38 100K .1% RN65
R36 14.7K .1% RN65
Q8 2N5551
C10 .01 63V
Q10 MPSA14
R27 475
Q14 MPSA14
R39 200
Q21 MPSA14
R51 200
CR1 CR160
R10 60.4
Q1 MPS8599
R13 20
Q4 MPS8099
R6 20
R17 20
C1 .022U 63V
R2 604 .1%
C2 2.2U 160V
C8 .01U 63V
R22 604 .1%
R1 100K .1%
R5 100K .1%
C3 1500P
R7 20
R18 20
Q2 MPS8099
R14 20
Q5 MPS8599
R11 60.4
CR2 CR160
D14 1N914b
R54 45.3
R55 20
D15 1N914b
D16 1N4936
R58 10
R60 2K
R62 2.61K
Q23 TIP127
C21 .01U 160V
R63 27.4K RN65
C22 .01U 160V
Q24 TIP122
R59 10
R61 2K
R64 2.61K
1N4936 D17
R56 20
D18 1N914b
R57 45.3
D19 1N914b
R66 150
C23 .01U 63V
R69 10
Q27 MJE15030
R72 10
Q29 MJE15030
Q25 MJE15030
R74 10K
R76 1.00
R67 100
CX
R65 200
C24 .01 63V
R71 158
R77 80.6 RN65
C26 .01 160V
C27 .68U 160V
R79 10 RN65
R83 10 RN65
R87 10 RN65
R91 10 RN65
Q31 MJ15024
Q33 MJ15024
Q35 MJ15024
Q37 MJ15024
R81 .22 5%
R85 .22 5%
R89 .22 5%
R93 .22 5%
R122 .22 5%
R94 .22 5%
R123 .22 5%
R95 .22 5%
R82 .22 5%
R86 .22 5%
R90 .22 5%
R96 .22 5%
Q32 MJ15025
Q34 MJ15025
Q36 MJ15025
Q38 MJ15025
R80 10 RN65
R84 10 RN65
R88 10 RN65
R92 10 RN65
R75 10K
R68 150
C25 .01 63V
Q26 MJE15031
R78 1.00
R73 10
Q30 MJE15031
R70 10
Q28 MJE15031
C28 680U 75V
C31 .01 160V
C34 .68U 160V
D20 1N4936
R46 10 5W
C58 .1 250V
C35 .01U 160V
1N4936 D21
C29 680U 75V
C32 0.01 160V
C33 .68U 160V

O.G. = OUTPUT GROUND

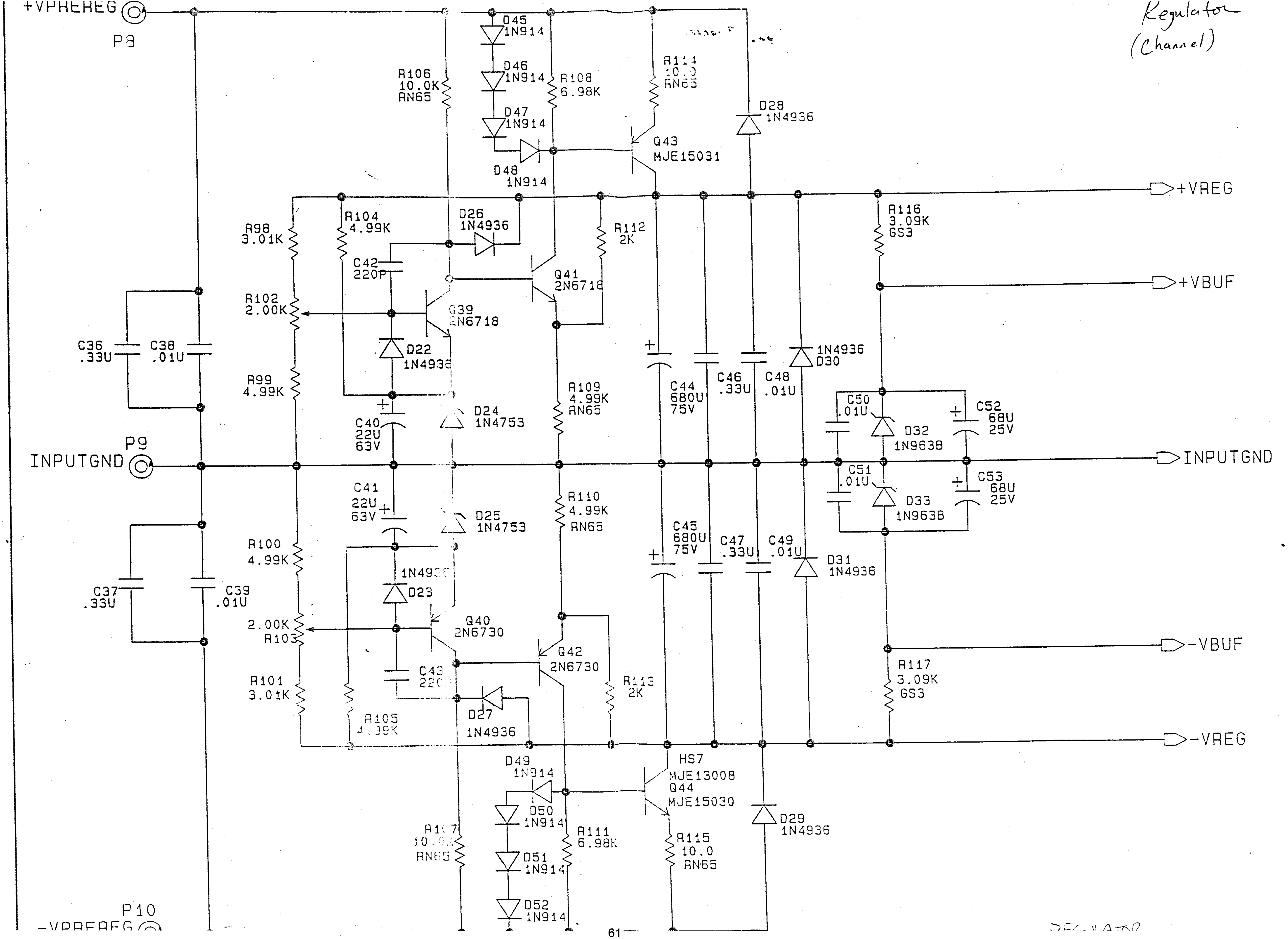
OL-3 SCHEMATIC

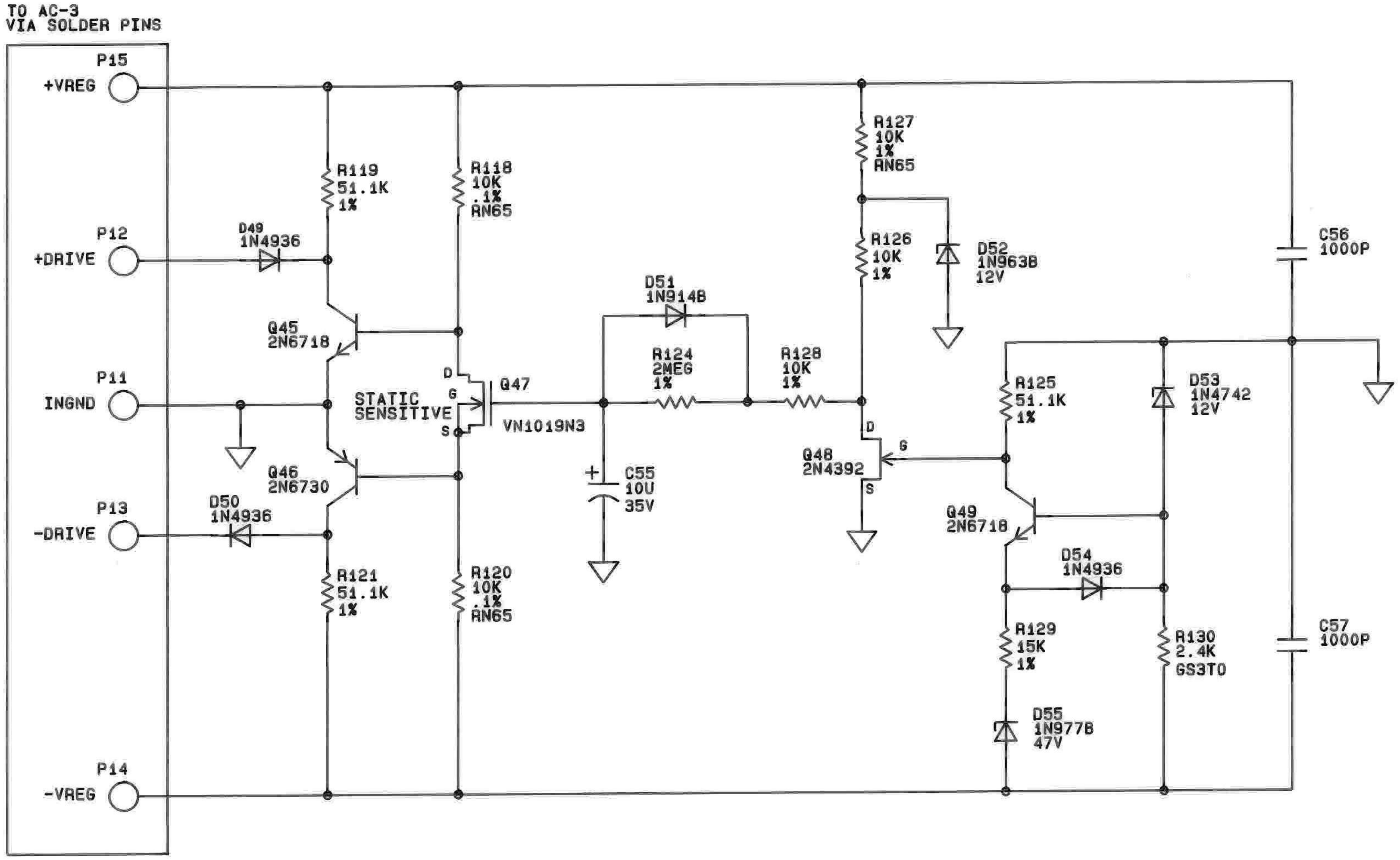

P5
CHASSIS
NEUTRIK IN
P15
1
2
3
GL
C14
.01U
C15
.47
P12
CHASSIS
P6
-IN
F.B.
R31
100
.1%
F.B.
P9
-SIGNAL
C10
100P
C11
100P
P7
INGND
P10
SIGNALGND
C12
100P
C13
100P
P8
+IN
F.B.
R30
100
.1%
F.B.
P11
+SIGNAL
+INPUT
INGND
P4


7_PIN_MOLEX
P1 5 +VUNREG
P1 6 THERMAL
P1 7 +DRIVE
P1 4 +EMITTER
P1 3 -EMITTER
P1 1 -DRIVE
P1 2 OPTOSEND
R1 20.0
1N4936 D3
1N4936 D5
1N4936 D7
1N4936 D9
1N4936 D11
20.0 R5
45.3 R9
10.0K
Q1 2N6730
D13 1N4003
R3 82.5
R13 100
C1 470U 10V
R7 1.00K
R11 45.3
D14 1N4936
Q3 2N5551
R12 45.3
R8 1.00K
D15 1N4936
C2 470U 10V
R14 100
Q4 2N5401
R4 82.5
D16 1N4003
R6 20.0
R10 45.3
Q2 2N6718
R2 20.0
D4 1N4936
D6 1N4936
D8 1N4936
D10 1N4936
D12 1N4936
R16 10.0K
P3 +SPKR
P13
P2 -SPKR
P14
C4 .01U
R18 4.32K
D17 1N4936
D18 1N4936
R19 4.32K
C6 .01U
C5 .01U
R23 20.0K RN65
C9 .1U
R26 10.0K
R21 1.00K
C7 .47U
D19 1N4003
Q6 2N5401
R27 10.0K RN65
R22 1.00K
R25 1.00K
Q5 2N5551
R29 16.2K RN65
R24 10.0K
D22 1N4003
D20 1N4003
R20 27K 1%
D21 1N4003
C8 470U 10V
D23 1N4003
R28 10.0K

OL-3

Regulator
(Channel)


+VPREREG
P8
D45
1N914
D46
1N914
D47
1N914
D48
1N914
R106
10.0K
RN65
R108
6.98K
R114
10.0
RN65
Q43
MJE15031
D28
1N4936
+VREG
R98
3.01K
R104
4.99K
D26
1N4936
R112
2K
R116
3.09K
GS3
C42
220P
Q41
2N6718
+VBUF
R102
2.00K
Q39
2N6718
C36
.33U
C38
.01U
D22
1N4936
R99
4.99K
R109
4.99K
RN65
C44
680U
75V
C46
.33U
C48
.01U
1N4936
D30
C50
.01U
C52
68U
25V
D32
1N963B
C40
22U
63V
D24
1N4753
P9
INPUTGND
INPUTGND
C51
.01U
C53
68U
25V
D33
1N963B
C41
22U
63V
D25
1N4753
R110
4.99K
RN65
C45
680U
75V
C47
.33U
C49
.01U
D31
1N4936
R100
4.99K
1N4936
D23
C37
.33U
C39
.01U
2.00K
R103
Q40
2N6730
-VBUF
Q42
2N6730
C43
220P
R113
2K
R117
3.09K
GS3
R101
3.01K
R105
4.99K
D27
1N4936
-VREG
D49
1N914
HS7
MJE13008
Q44
MJE15030
D50
1N914
D29
1N4936
R107
10.0K
RN65
R111
6.98K
R115
10.0
RN65
D51
1N914
D52
1N914
P10


TO AC-3
VIA SOLDER PINS
P15
+VREG
P12
+DRIVE
P11
INGND
P13
-DRIVE
P14
-VREG
R119
51.1K
1%
R118
10K
.1%
RN65
D49
1N4936
Q45
2N6718
STATIC
SENSITIVE
D
G
S
Q47
VN1019N3
Q46
2N6730
D50
1N4936
R121
51.1K
1%
R120
10K
.1%
RN65
D51
1N914B
R124
2MEG
1%
C55
10U
35V
R128
10K
1%
R127
10K
1%
RN65
R126
10K
1%
D52
1N963B
12V
Q48
2N4392
D
G
S
R125
51.1K
1%
D53
1N4742
12V
Q49
2N6718
D54
1N4936
R129
15K
1%
R130
2.4K
GS3TO
D55
1N977B
47V
C56
1000P
C57
1000P

ORIGINAL IN RED

● Part # 580180 / CA 2716
OR
● Print # 940631

Release date:

Type of release: ☐ Prototype ☒ 1st production ☐ Pilot ☐ Revision

Comments:

Drafting approval: Engineering approval:

Issued by: Date: 5-20-91
SIGNATURE

ISSUE	REVISION	DATE

TOLERANCES
UNLESS SPECIFIED

FRACTION +-.010
DECIMAL +-.005
ANGLE +-1/2°

DR. A.M. DATE 5-20-91
CH. XXX DATE 0-00-00
SCALE:

MADRIGAL audio laboratories, inc.
2081 south main street middletown connecticut 06457 u.s.a.

MATERIAL

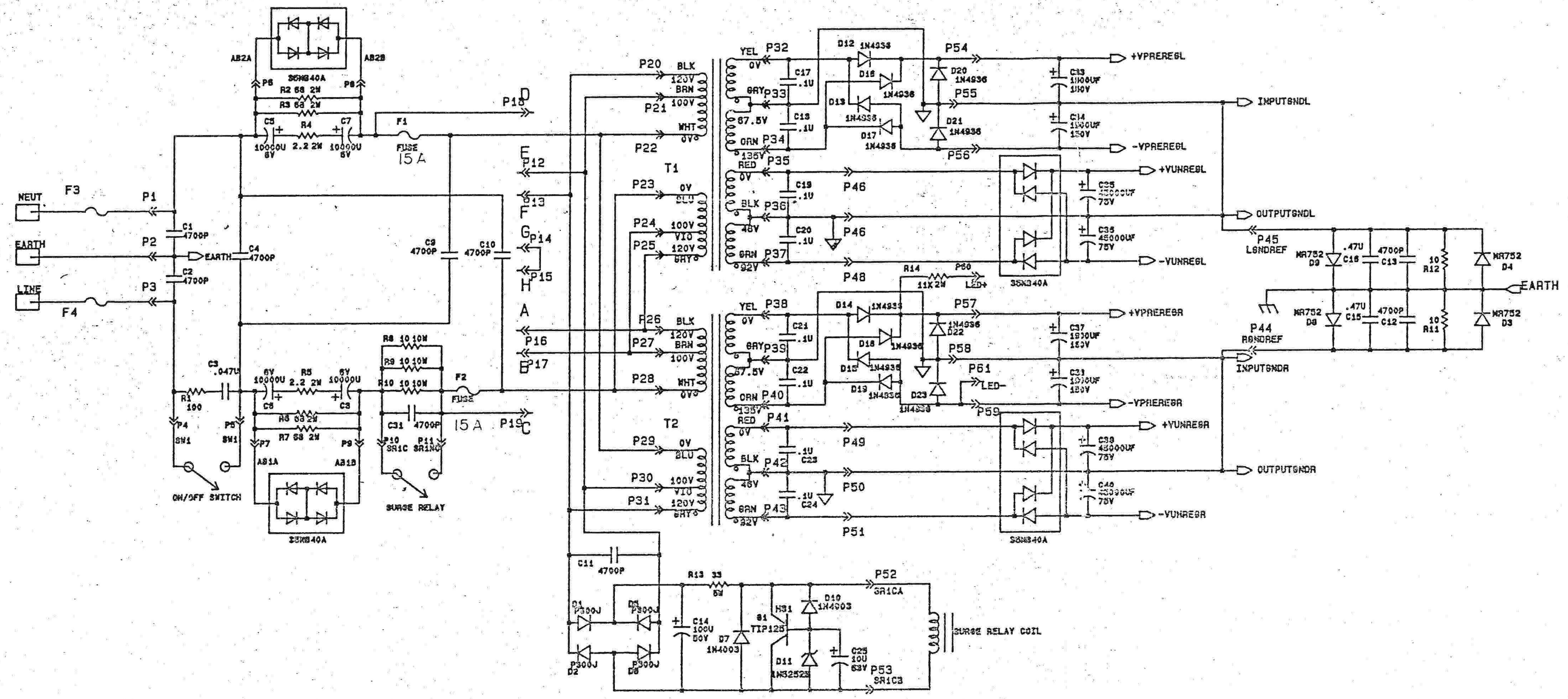
SHEET OF SIZE B

A B C D E

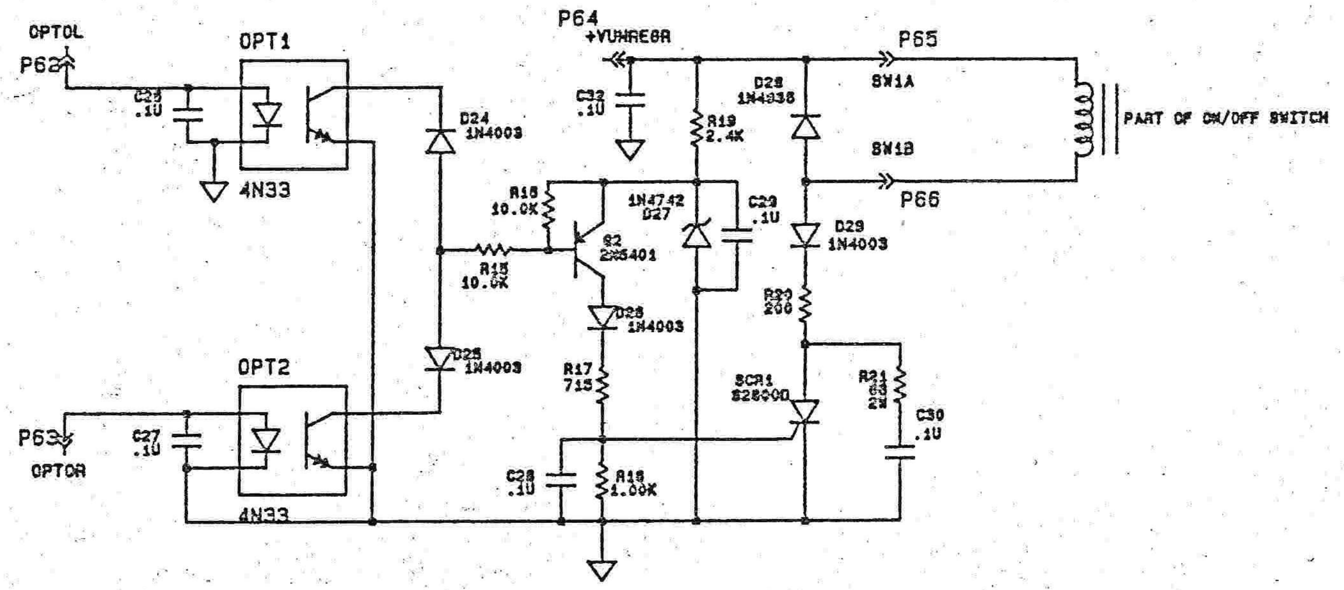
USED IN
No.27

NAME
AT2 SCHEMATIC

NO.
940631



AB2A
AB2B
3SKB40A
P6
P8
R2 68 2W
R3 68 2W
C5
R4
C7
10000U 6V
2.2 2W
F1
FUSE
15 A
P18
D
NEUT
EARTH
LINE
F3
F4
P1
P2
P3
C1 4700P
C2 4700P
C4 4700P
C3 .047U
C9 4700P
C10 4700P
R1 100
P4 SW1
P5 SW1
R5 2.2 2W
C6
C8
R6 68 2W
R7 68 2W
P7
P9
AB1A
AB1B
ON/OFF SWITCH
R8 10 10W
R9 10 10W
R10 10 10W
F2
FUSE
C31 4700P
P10 SR1C
P11 SR1NO
SURGE RELAY
P19
C
E
P12
P13
F
G
P14
H
P15
A
P16
B
P17
P20
P21
P22
P23
P24
P25
P26
P27
P28
P29
P30
P31
BLK 120V
BRN 100V
WHT 0V
0V BLU
100V VIO
120V GRY
T1
T2
YEL P32 0V
GRY P33
67.5V
ORN P34 135V
RED P35 0V
BLK P36
48V
GRN P37 92V
YEL P38 0V
GRY P39
ORN P40 135V
RED P41 0V
BLK P42
GRN P43 92V
C17 .1U
C18 .1U
C19 .1U
C20 .1U
C21 .1U
C22 .1U
C23 .1U
C24 .1U
D12 1N4936
D16 1N4936
D13 1N4936
D17 1N4936
D14 1N4936
D18 1N4936
D15 1N4936
D19 1N4936
D20 1N4936
D21 1N4936
D22 1N4936
D23 1N4936
P54
P55
P56
P57
P58
P59
P61 LED-
P60 LED+
R14 11K 2W
P46
P48
P49
P50
P51
+VPREREGL
INPUTGNDL
-VPREREGL
+VUNREGL
OUTPUTGNDL
-VUNREGL
+VPREREGR
-VPREREGR
+VUNREGR
OUTPUTGNDR
-VUNREGR
C33 1000UF 100V
C14 1000UF 100V
C37 1000UF 100V
C31 1000UF 100V
C35 45000UF 75V
C36 45000UF 75V
C39 45000UF 75V
C40 45000UF 75V
3SKB40A
P45 LGNDREF
P44 RGNDREF
INPUTGNDR
MR752 D9
MR752 D8
MR752 D4
MR752 D3
C16 .47U
C15 .47U
C13 4700P
C12 4700P
R12 10
R11 10
EARTH
C11 4700P
D1 P300J
D2 P300J
D5 P300J
D6 P300J
R13 33 5W
C14 100U 50V
D7 1N4003
Q1 TIP125
D10 1N4003
D11 1N5252B
C25 10U 63V
P52 SR1CA
P53 SR1CB
SURGE RELAY COIL



OPTOL
P62
C26 .1U
OPT1
4N33
OPT2
P63
OPTOR
C27 .1U
4N33
D24 1N4003
D25 1N4003
P64 +VUNREGR
C32 .1U
R19 2.4K
D28 1N4936
P65 SW1A
SW1B
P66
PART OF ON/OFF SWITCH
R16 10.0K
R15 10.0K
Q2 2N5401
1N4742 D27
C29 .1U
D26 1N4003
D29 1N4003
R17 715
R20 200
SCR1 S2800D
R21 68 2W
C30 .1U
C28 .1U
R18 1.00K

AC MAINS	JUMP
100V	C-E, B-D
120V	C-F, A-D
200V	B-E, G-H
220V	A-E, G-H
240V	A-F, G-H

VB5 & CHASSIS WIRING
PRELIMINARY 1-23-89